JAI SCIENTISTS

By

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The pioneer of Surgery in ancient India

SUSRUTA

Susruta, an Ayurvedic physician of the 6th or 7th century B.C. known as "Father of Indian Surgery" learnt the art and science of Surgery from Dhanvantari in the Himalayan region.

The term 'Susruta' literally means 'to listen well', i.e. he has learnt his subject after listening to experts in the field.

Wealth of Susruta

Susruta designed his instruments on the shape of birds' beaks (viz. to hold firmly); Susruta - Swastika type: beast faced; bird faced; Susruta - Salaka type: rod like; Susruta cutting type, etc. Thus they indicate shapes and their function.

Medical Knowledge

Priniciples of Medicine, Surgery, Midwifery, Pharmacology, Human body (anatomy)

Botanical Knowledge

Some generalia, Medicinal plants, Flora of Susruta, Botanical identification – Pharmacolinguistics.

Susruta Samhita is his master piece – this book describes all his surgical skills:

i) Transplanting viable skin flaps, say from neck to face etc., – forerunner attempt of the present day plastic surgery.

ii) Plastic surgery to reshape the nose which has been cut off.

iii) The art of crouching a cataract. At that time, this was unknown in Greece or Egypt.

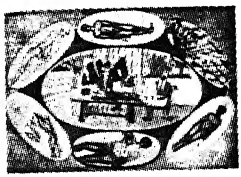
iv) He devised a novel method of ligature using ant's head as the suturing material.

Boldness, quickness and immediacy in action, sharpness of the instrument, non-sweating and non-trembling, and lack of confusion— these are what are praised in a surgeon's act.

— *Susruta Samhita Su* 5.10

Past generations, through their work, struggles, failure and success, laboriously laid the foundation upon which the material and intellectual structure of modern societies could be erected. —Ramstad, E. *Modern Pharmacognosy*

Ancient Hindu/Indian medicine, as we find in Atreya and Susruta, is like the Hippocratic medicine of Cos and Cnidos.



Jivaka who understood 'Jivitam'

JIVAKA

Jivaka: Ayurvedic Physician of India in the sixth and fifth century B.C. was born in the Magadha Empire in the reign of Bimbisara, in the time of Gautama Buddha.

He was well-versed in Pediatrics, brain surgery, abdominal operations. He was a disciple of Atreya, the renowned Professor of Taxilla (Takshasila) University. He was crowned as the 'King of Physicians and Surgeons'. Tibetan and Pali scriptures praised about Jivaka. He was a physician to Buddha and the Buddhist monks.

Lord Buddha was born by a Caesarean operation.

Eight important branches of Ayurveda

1) *Kayachikitsa* or Internal medicine.

2) *Salya tantra* or Surgery.

3) *Salakya tantra*: Treatment of diseases of head and neck.

4) *Agada tantra* or Toxicology.

5) *Bhuta Vaidya*: Management of seizures by evil spirits and other mental disorders.

6) *Bala tantra* or Pediatrics.

7) *Rasayana tantra* or Geriatrics including rejuvenation therapy.

8) *Vajikarana tantra* or Science of aphrodisiacs.

Many conferences of sages meeting in the Himalayas used to discuss the means of alleviating human suffering due to diseases; the outcome was Ayurveda (the science of life). Some view it as the Fifth Veda.

The curse of the science of medicine, as of all sciences, has always been the so-called practical man, who will consider the immediate end of his art, without regard to the knowledge on which it is based.

– Singer C and EA Underwood, *A Short History of Medicine* p 69.

Unfortunately Lord Buddha succumbed after an operation by an Ayurvedic Surgeon and thereafter Ayurvedic surgery went into disrepute.

Greek genius in " 'he' between two' mats' and 'ics' "

PYTHAGORAS

Pythagoras of Samos(582 to 502 B.C.) was a Greek genius in Mathematics who flourished in ancient times about 2500 years ago. He was born about 582 B.C. in Samos, Greece in a rich family.

At the age of 16 he was a student prodigy. Printing of books was not known in those days. The only way was to express one's views and to interact with others. He travelled through the Mediterranean, Persia, Babylon, Arabia, India. Gowthama Buddha was founding his religion in India during that time. Pythagoras learned music in Egypt and tried to establish mathematical principles to music; the pleasing quality of sound depends upon the stretch of the string, e.g. 2 to 1 represents octave.

He migrated to Croton in Southern Italy about 530 B.C. He established a philosophical and religious school framed on views of brotherhood which came to be known as Pythagoreanism. Soon he could gather about 300 colleagues.

Pythagoras and his followers said that human soul is im-

mortal. This coincides with such a view in Bhagavad Gita.

न जायते म्रियते वा कदाचि –
न्नायं भूत्वा भविता वा न भूयः।
अजो नित्यः शाश्वतोऽयं पुराणो
न हन्यते हन्यमाने शरीरे ।।

Further, the soul returns to earth again and again, transmigrating into different people, which view is again substantiated in Bhagavad Gita – the cycle of birth, rebirth.

वासांसि जीर्णानि यथा विहाय
नवानि गुह्णाति नरोऽपराणि ।
तथा शरीराणि विहाय जीर्णा–
न्यन्यानि संयाति नवानि देही ।।

If a man lives a pure life, he would not be born into an animal womb in the next birth. The importance of self-discipline, austerity, plain- heartedness, temperance and modesty, obedience were the tenets of good living. Purposeful living and purity of thought, word and deed were the watchwords. Pythagoras practised Vegetarianism.

Studies in Pythagoreanism

1 . Metaphysics (the nature of "Being")

2. Religion and ethics: Friendship and modesty.

3. Number theory: The harmony of the cosmos was emphasised.

(a) The *tetraktys* (meaning "fourness") 1+2+3+4=10

(b) "One" is seen as both even and odd. This ambivalence applies to the total Universe.

Peripatetics (the school founded by Aristotle) praised Pythagoras as the educator of the Greeks who were very fond of preaching the gospel of humanity.

4. Mathematics and Science.

Arithmetic and Geometry, Science of musical tones and notes, harmonics were studied.

Geometry: Geo metry —implies measurement (mathematics) of world objects, e.g. cube, square, rectangle and the like.

(i) The Pythagorean theorem which is a popular fundamental basic concept which brought name and fame to Pythagoras, states that in a right-angle triangle the square on the hypotenuse (longest side) is equal to the sum of the squares on the other two sides, i.e. $3^2 + 4^2 = 5^2$ viz. 3x3 plus 4x4 equals 5x5 . A right-angle triangle is one in which one angle is 90^0 i.e. a "right" angle.

(ii) The sum of the three interior angles in a triangle is equal to two right angles i.e. 180^0.

5. Pythagoreans postulated that the Sun occupied the centre of the Universe, a fore-runner idea of Copernicus.

6. The four elements in the world and four qualities: World is made up of air, water, earth, fire; world composes of opposites, wet-dry, hot-cold, etc.

People began disliking the brotherhood as the members turned arrogant towards the ignorant. Pythagoreans fell into the web of politics. Disgusted and dejected, Pythagoras went into exile. His chapter came to a close at the age of 80.

Italy respected this great Greek 200 years after his death when the Senate in Rome built his statue and honoured him as "the wisest and bravest of the Greeks".

Father of Medicine

HIPPOCRATES

Hippocrates - "Father of Medicine" (460 B.C. to 377 B.C.) a Greek physician born in the Island of Cos. He placed medicine on a scientific, non-tradition oriented, secular basis. He emphasised the ethical standards in the profession.

This is an oath demanded of the young physician, about to start his medical practice:

Traditional version

"I swear by Apollo, the physician, by Aesculapius, Hygeia, and Panacea, and I take to witness all the gods, all the goddesses, to keep according to my ability and my judgement the following Oath:

To consider dear to me as my parents him, who taught me this art...

I will prescribe regimen for the good of my patients according to my ability and my judgement and never do harm to anyone. To please no one will I prescribe a deadly drug, nor give advice which may cause his death. Nor will I give a

woman a pessary to cause abortion.

But I will preserve the purity of my life and my art...

In every house where I come, I will enter only for the good of my patients, keeping myself far from all intentional ill-doing and all seduction,...

All that may come to my knowledge in the exercise of my profession or outside of my profession or in daily commerce with men, which ought not to be spread abroad, I will not divulge,...

I will keep this oath faithfully, may I enjoy my life and practice my art, respected by all men and in all times; but if I swerve from it or violate it, may the reverse be my lot."

Modern version of Hippocratic Oath

His = doctor's; to consecrate (his) life to the service of humanity.

Not to permit consideration of religion, nationality, race, party politics or social standing to intervene between (his) duty and (his) patient.

Not to use (his) knowledge contrary to the laws of humanity.

Consumer Protection Act

Now-a-days Consumser Protection Act is hanging like a Democles' sword to punish cases of proven negligence, wrong

treatment, etc.

Hence both from the ethical and social as well as professional point of view, the medical doctor's profession is at the cross roads.

A wise saying :

' Science must always be ready to re - examine its past.'

Father of Biology

ARISTOTLE

Aristotle (384 to 322BC), Great thinker, Father of Biology born in 384 BC was recognised as an early Greek scientist-philosopher. At the age of 17 he studied under Plato. Later Aristotle became a teacher to Alexander (who became Alexander the Great). He developed a talent for keen observation on the structure of living beings. He was the first person to make dissections (i.e. cutting open) of animals. H.G. Wells praised him as the first, natural historian.

He was perfect in biology but poor in physics; notwithstanding this, the influence of Aristotle's thought reigned for 1,500 years. Galileo Galilei (1564 to 1642) later disputed and discarded the till then highly-accepted Aristotelian theory of falling bodies, which argued that a two-pound weight will fall to the ground twice as fast as a one pound weight, based on his observation that a stone falls faster than a leaf (which is true, of course). Galileo demonstrated in the presence of a huge gathering that both heavy and light objects of the same shape, say balls, took the same time to fall to the ground from the Leaning Tower

of Pisa– Paradox of Truth! Lo! Truth alone triumphs. The public and even the Church criticized Galileo for challenging Aristotle's theories. It was proved that Aristotle was woefully wrong in physics, in the above context.

Copernican System opposed Aristotle's view that the Earth was a fixed object (see Nicolaus Copernicus)

Aristotle recognized the ladder of nature, the way in which living beings are classified, i.e. taxonomy.

According to him, the universe was made up of five elements, water, air, fire, earth and heavens (sky). This coincides with the much more ancient Indian interpretation. –

पृथिव्यापस्तेजोवायुराकाशात्

His writings include:

1) Logic – a proper tool of investigation.

2) Physics – scientific study of the properties of matter and energy, e.g. heat, light, sound, magnetism, gravity and the relationship between them.

3) Metaphysics –branch of philosophy detailing the nature of existence, truth and knowledge.

4) Natural sciences: Life sciences, Botany and Zoology.

5) Ethics, science that deals with morals in life, rules of conduct and behaviour.

6) Rhetoric and poetics.

He mustered about 1000 volunteers to travel through Greece and Asia collecting specimens of sea and land life, dissecting them and reporting their findings.

Thus Aristotle was a great man of science. He was 'A rising tot legend' – Aris tot le. His achievements were great, though some of them were clouded with error.

Pioneers in the systematic organised study of biology:

1. Aristotle (384 to 322 BC) Father of Biology

2. Theophrastus (370 to 285 BC) Father of Botany

3, Hippocrates (460 to 377 BC) Father of Medicine

Importance of Biology to Mankind

1. Medicine: Parasitology, Microbiology.

2. Eugenics : The science of improvement of human genetic stock.

3. Agriculture including horticulture.

4. Growth of industries, e.g. fisheries, silk manufacture.

5. Pollution control, environmental science.

6. Genetics, embryology.

Ancient mathematician – Mathematics is the mother of all sciences

EUCLID

Euclid, Father of Geometry, the ancient and most prominent mathematician of antiquity was known to have lived in Alexandria, Egypt round about 300 B.C. His treatise on geometry, the *Elements* , a book with a set of 13 volumes was written on papyrus; may it be known that printing was not yet invented by that time. This book was translated later into various languages. Next to Bible, the *Elements* was the increasingly published and most read book.

The English translation of the *Elements* was done by Sir Henry Billingsley; The Thirteen books of Euclid's *Elements* were translated by T.L.Heath.

Euclid's predecessors:

1. Thales, a Greek mathematician who studied Egyptian geometry methods in navigation, astronomy, land measurements and pyramid construction.

2. Egyptian surveyors of land were called 'rope stretchers'. They used a rope triangle; by stretching the sides, the angles of the triangle would vary.

3. Pythagoras, Plato.

4. Hippocrates of Chios (5th centyry B.C.) ; not to be confused with the noted physician Hippocrates of Cos, the Father of Medicine (who flourished in 4th Century B.C.).

It is recorded that Euclid was educated in Plato's Academy, a prestigious institution for mathematical education in those days.

"A scientist has to satisfy his curiosity by deducing facts only from already known principles; next, method of reasoning which has stood the test of time in logic would lead to research – this method is called deductive reasoning." Euclid started with simple definitions called axioms, later combined them into statements called theorems.

Egypt has been praised as the "Gift of the Nile" because it used to bring fertile soil from the mountains. Later Nile became the "River of Sorrow" since it was causing damage by floods and spreading the disease, Schistosomiasis; however, it was harnessed by the construction of Aswan Dam and restored to its previous glory as a gift to Egypt.

The land surveyors used to have a problem in measuring and alloting land to peasants. Geometrical methods/ropes helped them.

Ptolemy I Soter who reigned Egypt from 323 to 283 B.C. who was himself a learned man used to respect and honour poets, artists, mathematicians, astronomers and scientists; Euclid had his favour and recognition. The king established a museum in Alexandria and converted it into a library with 7 lakh books, all on papyrus, of course. Egyptians are known for their art of preservation, e.g., mummies. Unfortunately

they could not preserve papyrus books.

The pyramids of Egypt, one of the seven wonders of the world and the Sphinx were really feats in geometry.

Euclid made geometry into a logical subject. The principles of mechanics, sound, light, navigation, astronomy, biology, medicine and allied sciences are based on the concepts of Euclid. Mathematics is the mother of all sciences.

Where is not mathematics? Life activities depend on mathematics; for instance, walking, running, driving a vehicle involve mathematics because in the above activities speed and distance of objects are computed in the inner conscience.

Euclid was well-versed in music also. *The Elements of Music* was written by him.

The word Euclidian geometry was coined.

Abraham Lincoln studied Euclid's books to develop the power of reasoning.

CHARAKA

Charaka/Caraka, Ayurvedic physician lived in the period between the third and second Centuries B.C. He was the court physician of king Kanishka.

The term Charaka literally means 'wandering'/'touring'. He travelled far and wide and gained knowledge.

He was reputed as the principal exponent of kaya chikitsa.

Charaka Samhita is a compendium of 'Ayurveda' (science of life), a treatise in Sanskrit. This medical treatise was later translated into Persian, Arabic and Latin in the 8th Century A.D. It contains knowledge about plant, mineral and animal origin of some substances used in the treatment of diseases. Frequent urination with a ' sweet - tasting Urine' was described as diabetes mellitus in this ancient Ayurvedic classic- Onion, garlic, aloe, custard apple leaves, cabbage, *bael* leaves, turmeric have blood sugar - lowering action / effect . Aurveda hails Indianness.

Patanjali is known to have made a redaction of the *Charaka Samhita.*

Caraka and Atreya counted the number of bones in the

human body as 360; according to Susruta the count was 300. The human skeleton actually consists of about 206 separate bones of many sizes, shapes, and functions. This discrepancy in the number is explained by the fact that both Caraka and Susruta counted 'processes' or 'protuberances' on certain bones as individual bone pieces.

Caraka opined that thirty years was the limit of man's youth in his life.

Rejuvenation therepy in old age (*Vardhaka* and *jara*): 'herbs, herbal products (Vegetarian and fruitarian diet) and lemon, ginger, *amlaki, silajatu* (minerals) as aphrodisiac par excellence.

Postponement of physiological senescence : (i) commitment to non-violence for submerging anger (ii) moderation of diet.

Gleaning wisdom from ancient scientists is like a treasure-hunt of knowledge. Caraka said, "Happiness is impossible without *dharma.*" Therefore all individuals should stay tuned to the performance of *dharma*. Dharma, in short, is one's duty. A famous definition of *dharma* (which is insufficiently described as a religious merit) धारणात्, धर्म इत्युच्यते.

It is called *dharma* because it, viz., the principles of sustenance as cognised by the elite, maintains and supports the society or the individual; *dharma* is a moral obligation.

In the present day, we say

धर्मो रक्षति रक्षितः ధర్మో రక్షతి రక్షితః

ధర్మాన్ని కాపాడండి, ఆ ధర్మం మిమ్ములను కాపాడుతుంది.

Comprehension of the true nature of the disease and controlling of the pains(and the other distresses that arise thereby),– this is the physicianness of a physician. He is not the Lord of the span of the (patient's) life.

– *Brhma vaivarta 16*

What is a disease ? It is dis-ease. Anything that brings sadness and grief and suffering to the human person (or the *Purusha).*

Basic Scientist

ARCHIMEDES

Archimedes(287 B.C.to 212B.C. of Syracuse(Sicily).

Key words

1. Density(a)(physics) relation of mass to volume(b) The mass of a substance per unit volume.

The tighter the texture the more dense is the object; the looser the texture the less dense it is, e.g. an iron nail is more dense than a cork. In the case of liquids, mercury is more dense than water.

2. Upthrust, upward force, buoyant force: When an object is immersed in a liquid, the liquid exerts an upward force on the object, e.g. if a cork is immersed in water and mercury respectively, greater force is required to keep the cork in position inside mercury than inside water. Therefore the upthrust depends on the density of the liquid.

Experiments :

1.Take a piece of cork equivalent in weight to an iron nail and place them both on the surface of water in a vessel. The cork floats while the iron nail sinks, why?

The density of cork is less than that of water; the density of iron nail is more than that of water.

2.Experience while lifting a bucket of water from inside the well: its weight feels less as long as it is under water; soon it comes to the air, it feels more in weight. Why ? When the bucket is inside the water the upthrust on it makes it feel less in weight.

Archimedes' principle:

The upward force on an object totally or partially submerged in a fluid is equal to the weight of fluid displaced by the object.

When an object is immersed in a liquid, it is buoyed up by a force equal to the weight of the liquid displaced.

There are two forces acting on the object—the weight of the object acting downwards pushing it down and the buoyant force acting upwards pulling it up. The net result is an outcome of the strength of the two forces.

In the case of a ship, the weight of the volume of water displaced is always greater than its own weight, hence it sails [caution! if perchance water enters inside to the brim, it sinks due to the increased strength of the force (weight) pushing it down].

King Hiero of Syracuse summoned the services of Archimedes to test his crown, on a suspicion on the goldsmith, whether it was made of pure gold as per the contract or whether

any alloyed silver was mixed. An idea flashed in the mind of Archimedes while he was lying in his bath tub. He noticed that the level of water in the tub rose consequent on his body displacing the water. He jumped out, ran in ecstasy shouting "Eureka, Eureka"(I have found it). He filled a vessel with water, and dipped the crown in it, measured the water displaced. Next he dipped a mass of pure gold equal in weight to the crown, measured the water displaced. The amount of water displaced was different, which proved the fact that the crown was not made of pure gold. The goldsmith was a gold-thief.

Principle of Floatation

(i) Floatation of an iron ship: Since the ship is hollow and contains air in its empty space, the average density of the ship is less than that of water. The weight of the volume of water it displaces, is always greater than its own weight. Hence it floats.

(ii) Floatation of man: The average density of a live man is slightly greater than that of water, so he has to swim to save his life, when thrown into water. The dead body of man floats on the surface of water because it becomes less dense than water owing to the disproportionate increase in volume to that of weight, due to imbibition of water and gases. Also, the dead body is noticed with its head underneath the surface of water, because the density of his head is greater than that of water.

(iii) Submarines: Submarines are provided with floatation (or ballast) tanks. The ballast tanks are filled with water so that the average density of the submarine becomes more than that of sea-water and thus the submarine lies under water.

(iv) Iceberg: The density of ice is less than that of water. Hence iceberg floats on water.

(v) Balloons: Archimedes' principle applies to gases also. When a lighter gas like hydrogen or helium whose density is much less than that of air is filled in a balloon, the weight of the air displaced by the inflated balloon becomes greater than the gas-filled balloon and thus the balloon rises.

[Postscript : We see a photo of Thaddeus Lowe (1832-1913) American balloonist printed on aerogramme, USA]

Archimedes evolved the principle of levers. He lifted a loaded ship to the dock with the help of levers and pulleys, seeing which the witnessing crowd was wonder-struck. He made war machines with the aid of levers and pulleys. He even said, "If I am given a rod of proper length and proper place to hook its one end, I can lift the earth with the help of a lever" – such was the incredible poetic imagination of an ardent stalwart scientist's enthusiasm.

Sunburn of ships :

He had accomplished the burning of Roman ships by beaming the Sun's rays on to the ship with the help of huge mirrors.

The end came in 212 B.C. when a Roman soldier thrust his sword and killed this gifted mathematician scientist.

'Canon' – truly, a cannon of medicine

AVICENNA

Ibn Sina or Avicenna (980-1037 AD), a renowned Arabic physician who assimilated Greco-Arabic Medicine.

Abu Ali Ibn Sina (Avicenna) was known as the 'Arab Galen'. Galen (130-201 AD) was a Greek physician and medical scientist who practiced medicine in Rome.

His book *'Al- Quanoon - Fit –Tibb,'*, also called ' *Canon of Avicenna'* praised as *'Medical Bible'* had tremendous influence on the evolution of medicine in the Orient and among the European nations. The present British and American Pharmacopoeias are based on some of Avicenna's methods.

`Ibn Sina adopted the ancient humoral doctrine preached from the times of Hippocrates – the existence of four body humors (blood, yellow bile, black bile and phlegm) associated with the four elements (air, fire, earth and water). A proper and evenly balanced mixture of humors indicated harmony in health; disharmony results in disease. In addition, he believed in 'Ilaj-ba-zid' (contraria contraris curenter, the principle of

allopathy) and 'Ilaj-ba-misil' (similia similibus curenter, the principle of homoeopathy).

By the age of sixteen he learnt many sciences; at the age of 18 he became the physician of the Sultan of Bukhara. Gradually he wrote books and treatises on Medicine, Philosophy, Mathematics, Physics, Chemistry, Geology, Astronomy, Theology, Music.

His contributions : Observations on the close relationship between emotions and bodily changes, i.e., physiological psychology, physiology of sleep, importance of purifying drinking water, climatic influence on disease, dietetics, animal experiments, diseases like insanity, tetanus, tuberculosis, diabetes, heart problems, pulse and urine examination, trigeminal neuralgia (tic douloureux), meningitis, breast milk and infants, cosmetics, etc., Music as an integral part of therapy. He was an obstetrician, too.

ENT (Ear Nose Throat) diseases are dealt with in his book, *Canon of Medicine.*

Hence the highlights of his career as a philosopher, literary genius, scientist, physician and writer deserve appreciation.

Prior to Avicenna, there was no systematic description of diseases. His book *'Canon'* is renowned as a treasure of wisdom. We are reminded of Aristotle, Hippocrates, Galen and Plato whose thoughts are reflected in the life of Ibn Sina.

Birth millennium of Avicenna was celebrated in the year 1981.

Fitting tribute is paid to him in the following renowned poem about great lives:

Lives of great men all remind us
We can make our lives sublime
And departing leave behind us
Footprints on the sands of time.

'Many -in - one' scientist

LEONARDO DA VINCI

Leonardo da Vinci (1452 to 1519) "many talents-in-one" who earned the title "Universal man" was born in the village of Vinci near Florence in Italy in 1452. He was the illegitimate son of a reputed lawyer. His talents were versatile; he was an inventor, a painter, civil engineer, military engineer, astronomer, geologist, anatomist, architect, sculptor, designer, town planner and a pioneer aeronaut — talents galore.

His achievements

1. Painting: His famous painting 'Last Supper' was completed in 1497. The provocative smile of 'Mona Lisa', a painting completed in 1506 allures many a visitor in Louvre Museum in France. 'Madonna of the Rocks' is preserved in the National Gallery, London.

2. Engineering: Vast volumes of notes written in a right-to-left script, i,.e., to be read within a mirror was practised by Leonardo, to maintain his copyright, probably. Many of his technical notes and sketches in *'Codex Atlanticus'* were pre-

served in the Ambrosian Library in Milan; some 600 belonged to the British Royal Collection at Windsor Castle.

He explored virtually every field of engineering science, from grinding of lenses to construction of canals.

In civil engineering he designed streets, canals, churches, central heating systems and other town-plans.

The Duke of Milan engaged him as a military engineer, making drawings for war machines.

He devised a novel musical instrument,– *the lute*– in the shape of a horse's head.

He designed a diving suit and a submarine.

He was a cartographer, too.

Instrumentation: He designed an anemometer, which is a concept to measure the speed of wind.

Leonardo's clock indicated both hours and minutes.

Though automobile was not existent then, he devised the concept of a 'differential'. He gave idea about roller-bearings. The concept of 'gear' – his model of variable speed drive was a fundamental crux in automobile engineering.

Hydraulics was of special interest to Leonardo. He developed the art of irrigation and navigation, and work with piston pumps to raise water began to be recognised as aiding agriculture.

3. Sculpture: Leonardo worked as an apprentice sculptor under Verrochio, made models of wood, marble and metal.

4. Mathematics: Leonardo, as a school boy, showed his genius in solving intricate problems. Mathematics is the mother of all sciences – it is fitting enough, this prodigy imbibed versatility and established himself as a 'Universal man'.

5, Anatomy: His drawings exhibit a profound understanding of the structures in the human body like skull, spine, heart. He gave detailed descriptions of the heart chambers, valves.

6, Botany: He was aware of positive and negative helio tropism, geotropism. He pointed out the rings over the stem of a tree, depicting its age. He said that male and female plant life exists.

7, Glimpse into aeronautics: About 1490, observing birds fly, he argued that the same principle would apply to men also. But unfortunately people in Italy pooh-poohed such an idea and dubbed him as mad– "Man fly! indeed that's impossible" was their verdict.

He designed a flying machine, the flyer would flap the huge wings by the movement of his feet.

He also designed a kind of helicopter with the help of pulleys.

Anyway, the seeds of thought sown by Leonardo later bore fruit when Wright brothers invented the aeroplane.

His paintings, drawings and manuscripts show that his was the foremost creative mind of those days. With his life-long pursuit of knowledge in various disciplines, he earned and deserved the title 'Universal man'.

It is not the Sun that moves; it is the Earth

NICOLAUS COPERNICUS

Nicolaus Copernicus (1473 to 1543), a Polish astronomer was wellversed in mathematics, geometry, astronomy, geography, philosophy, theology, medicine, economics, law. He was an industrious student. Later he became a priest and statesman.

He was born on February19, 1473 in Eastern Poland.

1. He propounded the theory that Earth revolves round the Sun. Earth takes a daily rotation around its own axis and a yearly revolution around the stationary Sun. Earth is only a planet like other planets (the word planet meant "wanderer"in Greek language). The earth is not considered to be the centre of cosmos (Universe).

The nonrecognition of the Earth as the centre of the Universe caused an intellectual jolt amongst scientists. This is "The Copernican Revolution".

2. (a) In 150 A.D. Ptolemy, a famous Egyptian astronomer proposed the geocentric theory, viz., the earth at the centre of the Universe.

(b) The Copernican system opposed Aristotle's view that the Earth was a fixed object; it was almost a religious dogma till Copernicus put forth his revolutionary thought.

3. The popular and tradition-bound terms"sunrise", "sunset" are misnomers in the context of the Copernican system; "appearance" and "disappearance" of the Sun may be appropriate terms at the dawn and dusk respectively.

His father died when Nicolaus was ten years young. His uncle Lucas Waczenrode adopted this boy. At his age of 18 he entered the University of Cracow in Poland. Further training was obtained in the University of Bologna and Padua in Italy. He studied Greek language, mathematics, the writings of Plato, law and medicine. He was granted the degree of 'Doctor of Canon law' by the University of Ferrara.

4. Columbus travelled across the ocean and discovered America when Nicolaus was aged 19.

In 1503 at his age of 33 he returned to Poland to take care of his ailing uncle, Bishop Lucas after whose death Nicolaus settled in Frauenburg. A turret known as Copernicus Tower in the Cathedral stands in testimony of his fame; it was his observatory.

He gave succinct account of the orbits of the planets, the motions of the earth, the moon and the planets. This enabled a precise Gregorian Calendar to be devised later on.

5. In 1509 he made Latin translation of Greek verses, Theophylactus.

6. 1519 to 1528 he devised ideas in currency reform for some Polish provinces. Later Sir Issac Newton adopted simi-

lar suggestions to the Government in Britain.

7. In B.C. a Greek astronomer, Aristarchus of Samos had advanced a theory that the Sun was at the centre of the Universe but could not prove; hence it was ignored and relegated to the background. Occasion arose to Copernicus nearly 1800 years later, to prove this fact that in the midst of all dwells the 'Stationary Sun'.

Rheticus, a German genius scientist, a faithful disciple of Nicolaus Copernicus urged him to publish his book *De Revolutionibus Orbium Coelestium* popularly called "Revolutions"– English translation *"On the Revolutions of the Celestial Spheres"*. This ranks in its importance with "Principia" of Newton. It saw the light of the day on the last day of his life on May 24, 1543 when he was on his deathbed.

Barber surgeon

AMBROISE PARE

Ambroise Pare (1510 to 1590), great Frenchman was born in 1510 t Laval. He had started from humble beginnings and rose to great heights. He got a barber's apprentice since he belonged to a family of barbers. He worked as a barber dresser to the Hotel Dieu; he was assisting barber surgeons.

Pare served as a military surgeon. The Medical Faculty of Paris qualified him as a master barber surgeon.

He possessed great originality and powers of keen observation. He had gained the distinction of being appointed as the private surgeon to French Kings. He was serving the French armies and having his private practice in Paris. A famous saying of Pare— "I dressed him, God cured him."

In his earlier career Pare refers to an anecdote. After a battle, he was making rounds accompanied by the head-soldier caring for the wounded. They entered a barn and found three hopelessly injured soldiers. The head-soldier asked Pare if anything could be done to save them; Pare replied that nothing could be done. The veteran head-soldier took his sword

and chopped off their heads, "gently and without ill-will towards them". Euthanasia was existing at that time! When reprimanded by Pare, the head-soldier said that he prayed God that in similar circumstances someone would do the same for him (head-soldier).

Pare gave a succinct account of plague. People used to quit the house at the sight of a rat - fall in the vicinity and shift to neighbouring camps, viz., tents provided for temporary residence. The kith and kin abandon each other, judging the horror and peril of the pestilence.

It was a common practice to cauterise gun-shot wounds by pouring boiling oil into them; also bone ends of amputated limbs and blood vessels therein were cauterised. Pare proved that the so-cauterized wounds took longer time to heal. He ligated the bleeding vessels and healing was quicker.

Pare had to perform the first exarticulation of an elbow joint in a cowshed. The patient developed lockjaw (tetanus). Pare did not lose hope; he ultimately recovered.

Pare's inventive measures included instruments, artificial limbs, trusses for hernia, artificial eyes, tooth implants and method of podalic version in Obstetrics.

He devised his celebrated '*puppy salve*' for external application to wounds. It was prepared by mixing earth worms with Venetian turpentine, with the bodies of new-born whelps boiled in the oil of lilies— What a fantastic mixture of ingredi-

ents! Imagining in 1990-2000, 'a folly of the hoary past!?'

On the other hand Pare derided the popular use of two drugs- i) *Mumia*, the resinous debris of ancient Egyptian mummies; actually in practice, the dried powder from carcasses was masqueraded as *mumia*. Who could get such an easy access to Egyptian mummies? This was prescribed orally as a treatment for the pains of bruises and sprains. What a nauseating remedy! It smelled so badly; fisherman used it as a bait for catching fish! Ignorance is bliss—better not try such inhuman; erratic treatment.

ii) Powder of the horn of unicorn – In practice, the powder of the horn of rhinoceros or even any domestic animal, as an antidote to poisoning. This is also equally repugnant.

Pare enjoyed universal esteem. It is said that he was one of the few Protestants who escaped the massacre of St. Bartholomew's Day. He died in 1590 as an octogenarian.

Anatomy is scrutiny

ANDREAS VESALIUS

Andreas Vesalius (1514 to 1564) 'Father of Anatomy' was a Flemish anatomist who was born in Brussels in the year 1514.

Anatomy is that branch of medical science dealing with the structures and organs in the human body. It is a modern observational science.

Subgroups in anatomy

Osteology: Study of bones.

Embryology: Study of the embryo.

In the present context, anatomy refers to human anatomy. Each animal has its distinct anatomy.

As a youth, his mind was preoccupied with thoughts about cutting open animals called dissection. He was amused by the dissection of animals, birds and mice.

Andreas studied in the University of Louvain and medical school in Paris. He completed his medical studies in the University of Padua, a prestigious institution in Italy in those days. Padua produced many scientists. He worked as professor of anatomy and surgery in Padua till 1543.

People feel unaesthetic and view with disfavour the cutting of a dead body! Yet and but, this is the only way of learning. As medical students, scalpel and knife, viz., the instruments for doing dissection of cadavers greet us in the first year of study. It is to be emphasised that the medical student should dissect with his own hands with the help of scalpel and knife, not merely watch somebody else doing the job. The smell of dead flesh camouflaged by preservatives has a nauseating effect to start with, but soon the thirst for knowledge wins over this discomfort. Urge to learn is Divine; Work is Worship.

It is not uncommon for doctors to offer prayers before surgery.

The most embarrassing and challenging situation in Andreas' dissections of cadavers was to cast doubt on the infallibility of Galen who wrote his notes on human anatomy on the basis of dissection of barbary apes. When Vesalius pointed out error in Galen's work, the 1500 years standing and unopposed fame of Galen would get into jeopardy— authorities would say that the human body has changed in its anatomy since Galen's time, because nobody had the courage to disagree with Galen! Such was the victory of faith! Notwithstanding this, the test of time has proved that Andreas Vesalius was correct and Galen was wrong.

Jan Stephen van Calcar, a Flemish painter added colour to The *Fabrica*, book written by Vesalius by adding very good

illustrations; the drawings were most accurate and natural in tint, displaying life in the dead.

Andreas was physician to the Holy Roman Emperor Charles V and to Philip II, King of Spain. He prepared seven books– *On the Structure of the Human Body,* but hesitated to publish them fearing criticism would undermine the value. He died in 1564. Glory to the semi-centenarean who unearthed the fathoms of anatomy by patient and able dissections of the human body !

GALIELI GALILEO

Galieli Galileo (1564 to 1642) invented many hypotheses. His father wanted him to study medicine but he was keen to pursue mathematics.

1. A medicine-science oriented thought: At the age of 17 while reading psalm-book, he happened to observe that the chandelier in the Church was swinging to and fro and the time taken for each swing was the same as synchronized with his own pulse-beat, which served as a watch(there were no watches at that time).

2. (a) Experiment underneath a tree: He hung an iron sphere first and a light wooden block next, to the tree by a string (to simulate a chandelier as in 1. above) and made the string swing like a pendulum. The time taken for one swing was the same in both, independent of the weight. This observation provided the nucleus of thought for the pendulum of a clock.

2(b) When the length of the string was increased, the time also increased, and *vice versa.* Thus the swing of the pendulum varied in direct proportion to the length of the string.

3. Experiments on falling bodies:

As per the prevailing Aristotle's theory, heavy bodies fall faster than lighter ones. Galileo struck out this idea as wrong, even at the grass-root level. At the age of 23, he undertook this experiment.

3(a) A live demonstration in front of thousands of spectators: He threw two metal balls, one weighing 100 lbs and the other 1 lb from the seventh floor of the 'Leaning Tower of Pisa', from about a height of 180 feet. To the surprise of all, both balls took the same time to fall to the ground. (b) He took a long cylindrical tube closed at both lends, put two bodies of unequal weight making openings at one end and inverted the tube. The time taken for the two bodies to traverse to the other end was the same.

However, disproving a tradition evokes criticism as a way of the world. Galileo was looked down upon by Aristotle's followers; even the Church authorities despised his experiments as the influence of Satan!.

4. Invention of telescope:

Galileo assembled the first telescope in the world. Heavenly objects like the satellites of Jupiter, galaxy of stars in the Milky Way, etc., were visualised through this instrument. Far objects appeared nearer.

5. In the year 1616 he made known to the world that the earth revolved round the sun. This view was the same as that

of Copernicus. The 70 year old Galileo was put in prison by the Church authorities for ventilating the above views in his book. In 1637, he became blind; in 1642 he died.

In contrast to the humiliation he suffered in life, Galileo became immortal by way of recognition of his achievements posthumously (years after his death).

Heart , the most revered organ in the body punps blood, the elixir of life

WILLIAM HARVEY

William Harvey (1578-1657), English physician, discoverer of circulation of blood in the body was born at Folkstone on April 1, 1578 (not April Fool anyway, but an intellectual and immortal soul). His discovery revealed a truth which is a fundamental fact in physiology.

Harvey studied under Fabricius Aquapendente, the great anatomist in Padua, Italy, in the world-renowned School of Medicine in those days. Fabricius had found that the veins in the human body contained valves which prevented the flow of blood from any direction except towards the heart. This teaching gave the stimulus for thought to Harvey to proceed with his later work. The great Galileo was one of his teachers.

After obtaining the degree of Doctor of Medicine at Padua he came to London to set up his practice. In 1609 he was appointed as physician at St. Bartholomew's Hospital, a prestigious institution.

The human heart consists of four chambers, the right and left atrium and the right and left ventricle.

Galen from the first century AD, Fabricius and Sylvius, and 17th Century anatomists held the following view: The blood originated from the liver and was of two different kinds. One kind came from the right ventricle of the heart and travelled through the body by way of veins. The other kind came from the left ventricle and travelled through the body by way of the arteries. Thus both streams were believed to be quite distinct.

For years Harvey had been dissecting the bodies of fish, animals, frogs, snakes, rabbits, etc. In those days, cutting a dead human body was considered as an act against the will of God. Harvey used to enter the mortuary of St.Bartholomew's Hospital at nights, cut open the heart after few hours after death. It took 12 years for him to make sure that the circulatory system of animals and human beings was alike.

Harvey opened a vein and introduced a probe in it and discovered that the probe could be pushed one - way only, i.e., towards the heart but not in the opposite direction, confirming the teaching of Fabricius (valves in veins) loc. cit. The valves in the arteries permitted flow of blood away from the heart. The prevailing idea that blood travelled through the veins from the right ventricle *vide supra* was not justifiable, according to Harvey.

He observed that the heart in a living being moves up and down, functions like a pump; arteries pulsate synchronously with the heart-beat. In 1628 he propounded a theory that there were not two different kinds of blood in the body, *vide supra*.

Blood was only one product, whether in the veins or arteries. He opined that one mass of blood passed round and round (called circulation) being driven on its movement by the heart; Harvey called heart as the body's motor. The blood was pumped from the heart, passed through the body in a "kind of circle" and returned back to the heart. The blood stream was in continuous circulation.

He even estimated that the human heart pumped about two ounces of blood per each "stroke". The heart pumps more than a gallon of blood a minute, i.e., more than 1,500 gallons a day!

Harvey's reputation began dwindling for this revolutionary idea – "it was believed by the vulgar that he was crackbrained". All the physicians were against him. However, throttling bottle-necks do not jeopardize the triumph of truth in any venture. Truth establishes itself, at last.

King Charles I gave encouragement to Harvey who continued his research on anatomy. He was present at the battle of Edgehill which gave him tremendous opportunities in dissection of dead bodies, etc.

Harvey's discovery took shape in the 16th century when no research tools backed by electronic, computer-designed, sophisticated facilities were available (as in the present day).

At the age of 68 he was disabled with gout. On June 3,1657 he was struck down by paralysis.

An oration on his name was instituted. The Harvey Oration is still delivered annually.

Do you know ? The successful and durable heart transplant done in 1995 by an Indian Surgeon belonging to Andhra Pradesh in the All India Institute of Medical Sciences, New Delhi was an epoch-making event in the history of world Medicine.

A saga of a scientist boiling with enthusiasm

BOYLE, ROBERT

Boyle, Robert (1627 to 1691) Anglo-Irish chemist was born in 1627 in Ireland, the tenth son in a wealthy family. He learned Latin,French, English, Hebrew, Greek and Syriac.

In 1641 the 14 year old boy came to follow the footsteps of Galileo in Italy.

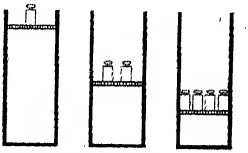
In the period 1645-55 he wrote many essays. One of his essays inspired the writing of Gulliver's Travels by Jonathan Swift.

During 1956-68 he resided at Oxford; got acquainted with Robert Hooke of Royal Society. In 1660 an informal group of brilliant scientists formed a society called the "Invisible College" which later was named as Royal Society of England.Boyle opined that air is necessary for combustion, respiration and the transmission of sound.

In 1961-62 Boyle's law was discovered with the following experiment. He constructed a glass tube "J" shaped with the shorter left end sealed; the longer right end was more than ten feet in length. He poured some mercury into the tube; the level was equal in both limbs. Mercury was poured slowly.

there was uneven rise in both limbs. When the long limb had 29 inches of Hg more than the short limb, the volume of the air inside the left limb was half the original! A column of Hg of about 8 feet compressed the air into a quarter of the original.

figure:



Boyle's Law: The volume of a gas varies inversely with the pressure.

Boyle's Law also called Mariotte's law: At a constant temperature the volume of a gas is inversely proportional to the pressure.

pv= k, k being a constant PV = P 'V'

P V pressure and volume under one set of conditions.

P 'V' pressure and volume under a different set of conditions.

Boyle attacked the Aristotelian theory of four elements– earth, air, fire and water and the three principles – salt, sulfur and mercury proposed by Parcelsus.

In 1968 he endowed Boyle's lectures. Boyle was a founder and fellow of the Royal Society. He was a prolific writer on variety of subjects –science, philosophy, theology, etc.

Other contributions

1. He investigated the speed of sound, the reasons for color.

2. Crystal structure. 3. Static electricity.

4. He embarked upon an experiment to discover oxygen –forerunner of Priestly.

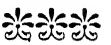
5. Animal will not survive, if devoid of oxygen.

6. Sulphur will not burn if heated in vacuum; therefore oxygen is needed.

7. He distinguished acids as different from alkalies.

In 1690 he wrote to Christian Virtuoso, "Study of Nature is a central religious duty."

He died in 1691. The tribute of his colleagues was, "Robert Boyle smells the truth".



Look into the microscope, don't look down on it

ANTON VAN LEEUWENHOEK

Anton van Leeuwenhoek (1632 to 1723) a grinder of lenses, a self-taught Dutch was born in Delft, the pretty town of windmills and canals in Holland on October 24, 1632.

While Galileo turned his telescope towards heavens and celestial objects, Leeuwenhoek manoeuvred his microscope to have a glimpse of the microscopic world and objects.

In 1673 the Royal Society of London received a letter from him entitled, "A Specimen of some Observations made by a Microscope contrived by Mr.Leeuwenhoek concerning Mould upon the Skin, Flesh, etc.; the Sting of a Bee,etc." The erudite members laughed at first at the venture of a grinder of of lenses, but later were astonished and respected his idea.

His was a single lens microscope; the lenses were ground to such a perfection that they have not yet been surpassed in quality. Grinding of lenses was a passion for him; they were shining like bubbles with his bubbling enthusiasm. The size of the lens was about one-eighth inch in diameter, say of the

dimension of the letter 'O'. His was a "simple microscope". It could beat in efficacy the compound microscope with two system of lenses. In all, he made over 400 magnifying lenses. He improvised delicate and strong strands which supported the lens in the instrument called microscope.

He studied diverse objects under his microscope like spermatazoa of dogs, blood cells, bacteria and protozoa; the most powerful of his instruments could magnify an object 275 times. As knowledge progressed, modern optical microscope was devised to magnify about 2,500 times. With the advent of electron microscope the magnification attempted is over 100,000 times.

His neighbours in Delft ranked him as a mad cap, always at scrutiny under the microscope. He described the microscopic objects as "wretched beasties". When rain water was stored for some days "animalcules" appeared under his microscope; those were brought by wind and dust, he thought.

He pricked his finger with a needle, allowed blood to ooze, examined in it red blood cells. In 1674 he informed this to the Royal Society. Later he examined the sperm cells produced by dogs and other animals. Still the Royal Society wanted to verify the findings of this self-tutored, unassuming commoner Dutchman, in the context 'science vs fiction'. Robert Hooke and Nehemiah Grew were entrusted with this responsibility. To the astonishment of one and all, they agreed to the exist-

ence of this 'microscopic world', looking into this mysterious microscope! Anton was honoured and elected a Fellow of the Royal Society in 1680. Paris Academy of Sciences had also received letters from him.

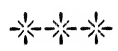
The Russian Ruler, Peter the Great and the Queen of England paid a visit to him. They were enthusiastic to look into his microscope.

In 1683 Anton drew drawings of bacteria. Gradually he studied decaying matter, eggs of insects. He saw the capillary blood vessels in the tail of a fish while examining under his microscope.

Leeuwenhoek lived to a ripe age of 91, still hale and healthy. Thus he grounded his body tissues to live long *pari passu* his art of grinding the lenses.

Present day microscopes :

Binocular, compound, dissecting, electron, fluorescence, infrared, light, polarisation/polarising, stereoscopic, ultraviolet and X-ray microscope.



If I have seen a little further, it is by standing on the shoulders of giants — Issac Newton

SIR ISSAC NEWTON

Issac Newton (1642 to 1727), Discoverer of Gravity Laws.

Newton was born on December 25, 1642 on Christmas Day at Lincolnshire, a Christmas gift to the Scientific world. He was born prematurely to a frustrated widow as a tiny tot, undersized, low birth weight, hardly expected to survive. But lo ! angel of Luck nurtured him to grow as a giant in Science with a fruitful life-span of 85 years.

He studied at the Grantham Grammar School and did his BA at Trinity College, Cambridge.

In 1665, while holidaying, he noticed a ripe apple falling on the ground with a 'thud'. He argued in himself,"why did the apple fall on earth straight down, not to right, left or up into the sky?"

He concluded that gravity is the force of attraction between two bodies, viz., the earth and apple. All bodies attract

each other by some force. However, mass is not the only factor concerned with the force, i.e., fall of the apple but 'distance' is another factor of equal importance.

According to this law, every body in this universe attracts every other body with a force which is directly proportional to the product of their masses and inversely proportional to the square of the distance between the two bodies.

"Why is the moon hovering above the earth? Why does not the Moon fall on the earth like the apple?" — Such questions always haunted him. There must be some force interacting between the Earth and the Moon preventing this catastrophe!

This law was unchallenged for over two centuries until Albert Einstein put forth his theory of relativity. Einstein opined that Newton's above law was valid as long as one was dealing with weak gravitational forces as present on earth. But when considered in context to black holes, quasars etc., wherein powerful gravitational forces with intense electromagnetic radiation are involved, Newton's law did not apply.

His expertise

1. His hand-made stone, sundial, now in the possession of the Royal Society of London.

2. His view about the cornerstone of scientific advancement; "The best and safest way of doing scientific work seems to be, first to enquire diligently into the properties of things,

and of establishing these properties by experiement, and then to proceed slowly to theories for the explanation of them ".

3. The "Principia" - three sections called "books" ,a unique work in Latin emphasised that all motions, whether on earth or in the sky, were expressed by the same laws . In the third book he calculated the mass of the sun and of the earth.

His Contributions

*Three laws of motion.

1) An object continues in a state of rest or constant velocity unless acted on by an external force.

2) The resultant force acting on an object is proportional to the rate of change of momentum of the object, the change of momentum being in the same direction as the force. F=m xa

Force = mass x acceleration

3) If one object exerts a force on another object, then there is an equal and opposite force (reaction) on the first object exerted by the second. [figurative comment: this is an experience in daily life].

*VIBGYOR: Sunlight which appears white is a mixture of seven colours, violet, indigo, blue, green, yellow, orange, and red. By rotating the Newton's Disc, the seven colours are merged into white.

*Newton's law of cooling.

*Newton's rings, Interference patterns.

* Calculus: A branch of Mathematics.

Other Achievements

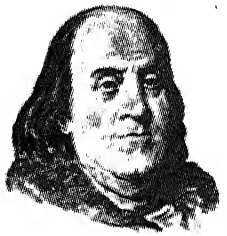
Worked as a Professor of Mathematics at the age of 27 in Trinity College. In 1703, he was elected as President of the Royal Society and re-elected every year until his death. In 1705, he was knighted by Queen Anne.

Newton deserved the three letters 'New' in his name, by virtue of his inventions. His thinking was always new. By definition, Newton is a person who is new in his ideas [Cf. simpleton].

He died on March 20, 1727 in London. He was buried in Westminster Abbey, a prerogative for selected few. Though dead, he is immortal.

Key and kite experiment

BENJAMIN FRANKLIN



Benjamin Franklin (1706-1790) was born in Boston on January 17, 1706, as the tenth child in a family of 17 children. Ben's father, unable to pay for his schooling, put him reluctantly for work in a candlemaking shop. But, Ben put in efforts to educate himself, buying books in preference to food even. Thus the bud in Ben flowered eventually. He made outstanding contributions in science, literature , social service, philosophy, etc.

He developed the American Philosophical Society and founded the first mobile library in America. He established the Academy of Pennsylvania which later grew up into a University.

His key and kite experiment led to the discovery of 'lightning conductor', also called 'Franklin rod'. On a stormy day, Franklin and his colleague William flew a big paper kite; a pointed wire at the upper tip of the kite was to act as an "electricity collector" (from the clouds), and the string attached to the kite would be a "conductor" of electricity. He tied the hand-end of the string to a metallic key which would "store"

the electricity thus conducted. To his astonishment, he discovered that a spark of electricity jumped onto his hand! It was proved that lightning was due to a discharge of electricity between clouds. This discovery paved the way for the "lightning conductor". A sharply pointed iron rod is to be placed on the top of the building, i.e., at its highest point and let a wire run from the rod to the earth. The building will be fully protected from the devastation of "lightning electricity" since the electrical charge will be earthed / grounded.

Other discoveries

*Franklin stove for heating rooms (the counterpart of present day 'airconditioning').

*Bi-focal eye glasses.

*The Leyden jar, a basis for the parallel plate capacitor used in TV and radio today.

* Postulated that diseases spread rapidly in poorly ventilated rooms.

Other achievements

* His book *"Experiments and Observations on Electricty"* was ranked equivalent with the "Principia" of Sir Issac Newton.

* Elected to the Royal Society in London and to the Royal Academy of Science in Paris.

*Ben began publication of *Poor Richard's Almanac*, an annual calendar of events, church holy days weather forecast,

etc. This was Ben's 'Big Ben'.

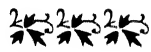
* Drafted the Declaration of Independence in 1766.

His *Autobiography* - a classic in American literature.

Apart from being famous for his discoveries, he was famous for his sayings. Sayings like, "God helps those who help themselves" and "Early to bed and early to rise makes a man healthy, wealthy and wise" and "Never leave that till tomorrow which you can do today" are relevant even today.

His thirst for invention is reflected when he once said: "I wish the good Lord had seen fit to make each day just twice as long as it is, perhaps then I could really accomplish something."

Glory be to this great man who cared for mankind.



Inspiration from the wine barrel in an inn

AUENBRUGGER

Joseph Leopald Auenbrugger (1722 to 1809) was born in Austria; he invented the art of percussion of the chest or abdomen to detect some diseases. The percussion note is resonance elicited when the chest is struck with flexed fingers. There are two varieties, direct and indirect.

The father of Auenbrugger was a prosperous inn-keeper who used to confirm the level of wine in a barrel by the aid of percussion. Young Auenbrugger took clue from this procedure.

At the age of 29 he was appointed in the Spanish Military Hospital. In 1761 he published his book *Inventum Novum* or *A New Discovery that Enables the Physician from the Percussion of the Human Thorax to Detect the Diseases Hidden within the Chest.*

A normal percussion note sounds like the note given by a drum covered with a woollen cloth ; the note becomes dull over the heart and over the right lower costal margin where the liver, a solid organ is situated. The note becomes 'stony

dull' over an effusion, i..e., fluid accumulated in the pleural cavity; the note is tympanitic over a pneumothorax, i.e., air in the pleural cavity/space.

Percussion is an art; it has to be mastered by assiduous practice. Wrong attempts like 'woodpecker's percussion' are not only non-informative but inelegant.

In view of the high prevalence of tuberculosis in Vienna at that time, he had a fund of clinical material.

Percussion is one of the four pillars in the (edifice of) "clinical diagnosis" – inspection, palpation, percussion and auscultation.

Auenbrugger was a busy practitioner, his hobby was music. He wrote a light opera, *The Chimney Sweep*. He was knighted because of his personal popularity.

Hunter who hunted for unusual specimens

JOHN HUNTER

John Hunter (1728 to 1793) Scottish surgeon, anatomist, physiologist and pathologist was born near Glasgow in 1728. In his boyhood he used to study Nature, animals and birds – the fore- runner indication of the would - be anatomist; coming events cast their signals.

He said all the body fluids possessed ' vitality ' and the blood was 'alive'. He was a co-physician along with his brother William Hunter; both were practising in London, much to the acclaim of the public .

He found pleasure and thrill in contacting the "resurrection-men" or grave robbers to bargain the supply of cadavers to his brother's dissecting room. He used to collect lizards, feed them with earthworms and follow their digestion.

Later he worked as resident house-surgeon under Percival Pott whose name is associated with 'Pott's Disease', TB of the vertebrae and 'Pott's fracture', a break at the lower extremity

of the bones of the leg, an injury with which Pott himself suffered from.

He established practice in London. He built a structure designed for housing animals with stables, cages and caves and rooms for preserving mounted specimens. He obtained the carcasses of three whales. The skeleton of an Irishman renowned for his height and hence called a giant, was one of Hunter's highly valued specimens.

Hunter contributed to comparitive anatomy by starting with the dissection of lower animals and extending the study to higher animals. He became very famous as a busy practitioner in London. He rose to the position of Surgeon-General of the Army and visiting surgeon to St.George's Hospital. Edward Jenner, the discoverer of vaccination was his student.

His work in the day would start at five or six-o-clock, used to last till late in midnight; he used to burn the midnight oil. He was sleeping five hours at night. His was a life of busy and crowded schedule. In 1776 he was named Physician Extraordinary to King George III.

Hunter's contribution to surgery was his method of operation for aneurysm (a dilatation of an artery due to w ken-ing of its walls). In 1767 he developed syphilis fo wing self-inoculation with gonorrheal pus from a patient, proving the venereal nature of the two diseases, gonorrhea and syphilis —*a sacrifice of his health and life* !

He began getting attacks of angina pectoris as an after-effect of his mental tension, stress and anxiety. Attacks of angina were noticed even at rest. He said, "my life is in the hands of any rascal who chooses to annoy and tease me."

While delivering a lecture at St. George's Hospital, he succumbed to an attack of angina.

Upon his death he bequeathed to his family a museum of over 13,000 specimens including dissections of human anatomy, stuffed birds, animals, fossils, etc.

An eccentric giant of Science who weighed the Earth

CAVENDISH, HENRY

Physicist and Chemist was the richest man of his time in England just as Nizam of Hyderabad, India was the richest man in the world.

He was born nicely in Nice, France in 1731 into a highly aristocratic and rich family. He was acclaimed as "the richest of all learned men, and very likely also the most learned of the rich".

1. 1749-53 entered Cambridge University but could not complete his degree because of his secular outlook.

2. He inherited enormous fortune at his age of 40. He was a misogynist. He was a recluse –shy personality with a thin and shrill voice. He used to talk about science only with his scientist friends.

3. He was elected Fellow of the Royal Society in 1760.

4. "Fire" was the burning topic of those days. What was fire?

After burning any substance ash is obtained. The combustible entity was till then named "phlogiston". Cavendish coined the term "flammable air". He immersed bits of iron, zinc, tin into sulphuric acid and hydrochloric acid, collected

the bubbles produced (as a result of chemical action); he called this "air" – he ignited the air and it burned with a nearly invisible beautiful pale blue flame. He called this inflammable air as hydrogen.

The first hydrogen-filled balloon was flown in 1783.

5. 1784-85 Cavendish with his experiements on air said water is not an element but a compound (H_2 O).

Prriestley experiment: When a mixture of hydrogen and air was exploded by means of an electric spark, the walls of the vessel were covered with moisture. Priestley did not know how to explain it; Cavendish said it was water.

When hydrogen was burned in air, water has formed. We know oxygen is highly combustible. Explosions have occurred when petromax light and oxygen cylinders were kept near each other, during a surgical operation.

Common air is made up of nitrogen in a 4:1 ratio by volume.

Shall we say Cavendish is "the Father of Hydrogen"?

Cavendish discovered that 20% of the air we breathe is oxygen . He concluded that oxygen combines with nitrogen when there is an electric spark; such a mechanism occurs during lightning discharges and the compound is rained down on earth, fertilizer from the sky.

He isolated argon, a rare gas, less than 1% in the atmosphere.

6. Cavendish postulated that "potential", a degree of

electrification across conductors was directly proportional to the current which flows through them – a forerunner observation of Ohm's Law. In his days there were no instruments to quantify/measure, how did Cavendish manage? He turned his own body as a meter estimating the strength of the current, by grasping the end of the electrode with his hand and noting whether he could feel the shock in fingers, upto the wrist or elbow or entire arm. What an ingenious idea/brain!

7. In 1803 he was recognised as a foreign associate of the Instit de France.

8. Other contributions: study of meteorology, gold alloys

9. Major work, his last bout of research at the age of 70 Using Newton's Laws of Attraction, he established the specific gravity of the earth as 5.48. He literally weighed the earth (figurative description).

He was eccentric, wore old shabby clothes, his jacket literally fell apart; the three cornered hat gave an awkward appearance; the only existing portrait of Henry Cavendish was sketched surreptitiously. But the mettle was strong; he was a giant in science, a walking encyclopedia.

He died at the age of 78 in the year 1810 leaving no part of the property of his estate of more than a million pounds, to the cause of advancement of science, which lacuna, however was made good by the Cavendish family in 1871. All buildings of the Cambridge Physics department are named the

Cavendish Laboratories, from the halls of which six Nobel Prize winners in Physics or Chemistry emerged.

Cavendish was lavish in science and science alone, but didn't care for outward worldly appearance.

Discoverer of life gases

PRIESTLY JOSEPH

Priestly Joseph (1733 to 1804) born near Leeds, England, Physical scientist, clergyman and political theorist.

At his young age he mastered French, Italian, German, Arabic, and English. He got over a slight speech impediment, however, which acted as a trigger to trim him up. He was troubled with ill-health in childhood. In 1758 he was employed in a school. In 1761 he wrote *Rudiments of English Grammar* . In 1765 Edinburg University conferred LL.D. on him. He met Benjamin Franklin, the roving ambassador of the American colonies who inspired him to write the book, the *History and Present State of Electricity* in 1766 which work earned him a membership of the Royal Society. In 1767 he was appointed Minister of Mill Hill Chapel in Leeds.

He studied gases and "airs" as they were then called. He observed "fixed air" (carbon-di-oxide) as it effervesced from vats of fermenting liquors; a burning splint of wood was extinguished in this "air". He dissolved some of it in water and

invented soda water which sprang up into an industrial bonanza, the billion-dollar soda water industry offering ice-cream, soda, Cola drinks, ginger ale, etc., to please the palate; this venture earned him a gold medal. He was elected to the French Academy.

He wrote a book on description of gas experiments , *On Different Kinds of Air* (1772). Nitrous oxide, later called "laughing gas" was experimented upon. Later Humphry Davy got quite a kick out of it, on inhalation.

Impressed by his success which led to the flourishing soda water industry, Lord Shelburne offered him financial assistance and a good laboratory. On August 1, 1774 he did an experiment : a candle will burn in a colourless gas with a vigorous flame which was called by Lavoisier "dephlogistinated air", i.e., "Oxygen" (phlogiston was thought to be linked with burning and combustion— idea prevailing in the 18th Century chemistry). In 1775-80 Priestly did lot of experimentation to arrive at the fact that oxygen was the active principle of the atmosphere and realised its role in combustion and respiration. May we call him 'the Father of Oxygen'?

He discovered other gases in the atmosphere, ammonia, sulfur dioxide, nitrogen, carbon monoxide.

He established the fact that light is important to plant growth; photosynthesis in plants described; green plants gave off oxygen to the atmosphere. He placed a plant in a chamber devoid of oxygen; 10 days later a candle burned in the chamber denoting that the plant contributed oxygen into the surroundings.

During 1774-86 he wrote a book, *Experiments and Observations in Different Kinds of Air* –6 volumes.

From 1779 onwards he spent his life in Birmingham, the industrial city. He wrote a book on religion and theology, *History of the Corruptions of Christianity* (1782), on which lot of religious uproar was created. He was attacked and opposed; though not on strict orders of execution like Rushdie, the Iranian poet.

Priestly never bothered to patent his discoveries. The Lunar Society named "Lunatics" consisting of stalwarts like James Watt, Erasmus, Darwin undertook to subsidize Priestly's experiments.

The year 1791 turned out to be a bad year for Priestly. A mob in the second anniversary of the French Revolution smashed his library and laboratory, set fire to his house– an irreparable loss which Priestly continued to lament till his death. Priestly was branded a traitor and blamed anti-Christ.

He fled to the United States. He was respected in the alien land. The triumphant trio–Benjamin Franklin, Thomas Jefferson and George Washington gave him asylum.

In Pennsylvania he isolated the useful, but deadly gas, carbon monoxide; useful in the sense that it cooks your food, deadly in the sense that it asphyxiates. The carbon monoxide in automobile exhausts and cigarette smoke is virtually "death in small doses".

Joseph died in 1804 at the age of three score and ten.

The man who ' tasted ' electricity

ALESSANDRO VOLTA

Alessandro Volta (full name Count Alessandro Giuseppe Antonio Anastasio Volta) (1745 to 1827), Italian physicist, discoverer of "electrochemical energy" was born in 1745 at Como, Italy, at the foot of the Italian Alps.

After having earned a degree by the age of 17 he worked as a teacher in a High School in Como. At the age of 34 he established the Department of Physics in the University of Pavia in Italy where he pursued the path of research.

In 1775 he invented the electrophorus. a device which produces static electricity as a result of the rubbing of two objects. From this idea stemmed the important electrical component called capacitor or condenser.

In 1776-78 Volta discovered and isolated methane gas.

Has anyone "tasted" electricity? Volta did. How?.– By an Experiment (1) He placed a piece of tin foil taken from his cigarette box at the tip of his tongue. He placed the bowl of a silver spoon at the rear part of the tongue and allowed the handle of the spoon to touch the tin foil to complete the circuit. There

was a sour taste in the mouth.

Experiment (2) He held a silver and gold coin against the two sides of the tongue and connected them by a wire. Bitter taste emanated on the tongue.

Volta concluded that contact of two different metals produced electricity.

In 1791 Luigi Galvani did the following experiment on a dissected frog. A sharp brass hook was driven into the spinal cord and an iron scalpel held touching the leg muscle. When the iron scalpel touched the brass hook, the leg muscle twitched violently! Galvani called it "animal electricity" and opined that the body of the frog stored this electricity and released it when the body was touched with two different metals. Volta did not agree with the above explanation. He took two rods of different metal, dipped them in brine (solution of sodium chloride). When the two ends are made to touch, a spark emanated! He was overwhelmed with joy. In 1792 Volta discovered this concept of "dynamic electricity" or electric current. In Galvani's experiment, the tissues of the body including the leg (muscle) of the frog contain brine; it was the effect of generated electricity. The term "animal electricity" is not apt.

Volta collected coins of different metals, arranged them one above the other with pieces of cardboard soaked in brine inserted between the coins. In this pile of coins called "Voltaic pile", a copper coin was at one end and silver coin at

the other end— the forerunner idea of the modern battery. Two wires were soldered to the coins at both ends. A spark was noticed whenever the wires were made to touch. In the modern batteries, a stronger spark could be obtained if the rods are immersed in dilute acid.

Napolean honoured him as a Count in 1801.

Using modified type of Voltaic piles, scientists decomposed water into hydrogen and oxygen.

Volta could be called the ' Father of Electricity.' He died in 1827.

In 1893 the Congress of Electricians named the unit of electromotive force the "volt" in honour of Volta, a fitting tribute and a feather in his cap (posthumous, of course).

Definition of Volt

Volt : The unit of electromotive force (emf) is defined as the difference in electric potential that will cause a current of one ampere to flow through a resistance of one ohm.

Edward Jenner inoculates his own son

EDWARD JENNER

Edward Jenner (1749-1823). Small-pox, once a dreadful disease has become extinct now, with the result that vaccination against small-pox has been abandoned. But the efforts of great people like Edward Jenner remain immortal. During his time many died of small-pox; few who survived became either blind or disfigured.

Distressed at the horror, Edward Jenner, launched a drive to protect people against this scourge.

Nucleus of thought of his pursuit

There was a local belief that if once a person contracted cow-pox, usually caused due to the sores of cow's udders while milking, he will not contract small-pox. Cow-pox is a mild disease in which sores appear on the fingers and hands.

So Jenner decided to put this belief to test. On May 14, 1796 he inoculated an eight-year-old boy, James Phipps with the fluid from the cow-pox vesicles from the hands of a dairy maid. The boy developed mild attack of cow-pox. On July 1 he inoculated the boy with the fluid obtained from the vesicles of a man suffering from small-pox, amidst all opposition. To everyones's surprise, the boy did not develop small-pox, i.e., he became immune to small pox.

Subsequently, Jenner inoculated his own son, Robert with

the small-pox virus. That's how Jenner had sown the seed of the theory of vaccination to control infectious diseases.

Jenner's fame spread world-wide. Napolean became an enthusiastic patron of vaccination.

The clergyman in Holland, Switzerland, medical men in Russia – all favoured vaccination for the people, specially children.

Present status

Immunisation is achieved through vaccination. By this process, the defence mechanism of the body is strengthened. EPI(Expanded Programme of Immunization) started in 1970 by the Government of India as a part of the National Health Policy, intended to control six vaccine - preventable diseases, viz., polio, diphtheria, pertussis (whooping cough), tetanus, tuberculosis and measles. [pdpttm] Vaccination against Hepatitis B has been included, of late.

It is hoped that polio will be completely eradicated in the world by the year 2000 AD.

Atomic theory – one of the basic theories of all sciences

DALTON, JOHN (1766 to 1844)

'Father of Atomic Theory', self-tutored English chemist was born in Eaglesfield, England in 1766. He was as vigilant as an eagle, justifying his birthplace.

At the tender young age of 12 he was headmaster of Quaker School, styled as per the English way– 'he was 12 years old' [it ought to be '12 years young']; his pupils were elders. His hobby was weather study. He learnt Latin and Greek, studied mathematics and meteorology.

Later he moved to Kendal where he taught for twelve years. He started a Science Discussion Forum, but with a handicap of unattractive personality and unpleasing voice, he could not make further impact. He came into touch with John Gough, a scholar blind from birth, but who got familiar with plants in a radius of 20 miles by touch, taste and smell; he was a meteorologist too. Inspired by him, Dalton became a member of the Manchester Literary and Philosophical Society and sent his papers for nearly fifty years of his life.

In 1787 he started a diary; he used to make entries about meteorological observations–last entry was on his date of

death; it contained 2,00,000 entries, in all. He wrote, "If I have succeeded... I say almost solely – from universal assiduity."

In 1793 he published a book, *Meteorological Observations and Essays*. In 1808-1810 his book, *New System of Chemical Philosophy* hit the market. In 1817 he was elevated to the post of President of the Philosophical Society, an honorary office he held until his death.

He was a man of few words, unmarried, deeply dedicated to research.

His contributions

1. Observations on 'aurora' phenomena – luminous coloured displays in the sky caused by electrical disturbanbces in the atmosphere.

2. He used to lecture on formation of clouds, rainfall, atmospheric moisture, dew point, barometer, thermometer, hygrometer, etc.

3. Theory of partial pressures of gases – Dalton's law. Actually Charles' law ought to have been credited to Dalton.

4. Theory of colour blindness. He was himself color blind. Colour blindness is called Daltonism.

5. The cream of his work was on chemistry and chemical analysis.

6. The smallest particle in a substance is termed 'an atom'.

meaning in Greek 'not cuttable'. The indestructible nature of the atom is, however, disproved after atom-smashing, the atomic bomb.

Dalton paved the way for interpretation of 'atomic weight' of a substance. He made a table of atomic weights.

However, he erred in the case of water. He said one "simple" of hydrogen combines with one "simple" of oxygen to give one compound water (HO) ; he didn't know that two hydrogen atoms combine with one oxygen atom to form water (H_2O).

7. He devised a system of chemical symbols for elements.

8. He discovered butylene, ether.

This modest quiet man of Quaker faith received Gold Medal from the Royal Society of England in 1826. The French elected him to their Academy of Sciences.

As legend goes, forty thousand people filed past his bier when he died in 1944; thus he was respected on his deathbed.

Man behind the live wire of electricity

AMPERE, ANDRE -MARIE

Ampere, Andre-Marie (1775 to 1836), French physicist and mathematician, founder of electrodynamics (now called electromagnetism) was born in 1775 to a hemp merchant. As a boy, he was emotionally upset/moved by the execution of his father in the 'Reign of Terror' following the French Revolution.

He was a prodigy who mastered mathematics by the age of 12, just like Dalton who became headmaster of a school at the age of 12.

1801 Professor of physics and chemistry at Bourg.

1804 his beloved wife died; he plunged himself into scientific work after this blow.

1809 professor of mathematics in an institute in Paris.

So mathematics, physics and chemistry (MPC) is a 'Royal group'—versatile for a scientist.

He published papers on calculus, optics, astronomy, zoology, besides on MPC.

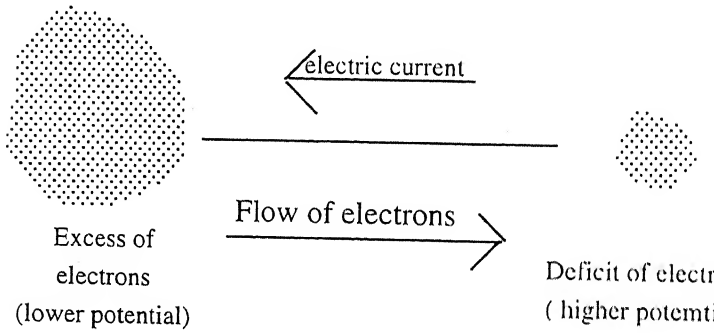
Based on the experiments of Oersted, a Danish scientist, Ampere observed a magnetic needle to move in the vicinity of an electric current; an electric current is capable of exciting a magnefic field; electric currents produce magnetic fields. In 1823 he published his famous treatise on magnetism and electricity.

Definition of ampere

(i) This is a unit of measurement of flow of electric current colloquially called 'amps'– 5 amps, 10 amps, etc. A flow of one ampere is produced in a resistance of one ohm by a potential difference of one volt. (ii) Current is defined as the amount of charge flowing per second (coulomb, a quantity of electrical charge) and is measured in ampere(A).

1 Ampere = 1 coulomb /1 second.

If two points, between which potential difference exists, are connected by a conductor, the current flows from higher potential (where there is deficit of electrons) to lower potential (where there is excess of electrons). The direction of current is opposite to the direction of flow of electrons.



An atom consists of a nucleus about which electrons rotate; moving electrons constitute an electric current.

In a cell: If two electrodes, say a zinc rod and copper rod are joined by a wire, the excess electrons from the zinc rod flow to the copper rod; inside the cell, the current flows from zinc rod to the copper rod whereas outside the cell, ie., in the

external circuit current flows from the copper rod to zinc rod.

Ampere's theorem gives the quantitative relationship between the strength of magnetic field and electric current.

Ampere built an instrument devising a free-moving needle to measure the flow of electricity, the principle behind the present day galvanometer.

Gift of science made him join the band of immortals. His name is given to the unit of electric current– the ampere.

AMEDEO AVOGADRO

Amedeo Avogadro (1776 to 1856), Italian physicist and chemist is one of the founders of physical chemistry.

In 1796 he received his doctorate in ecclesiastical law.

1809-20 professor of natural philosophy.

In 1811 he advanced Avogodro's hypothesis/law which states that equal volumes of all gases at the same temperature and pressure contain equal number of molecules. It is strictly true for ideal gases only. The term 'molecule' was coined by him. Shall we name him as the 'father of molecule'?

He distinguished between atoms and molecules, between atomic weight and molecular weight. He established the chemical formula of water as H_2O (rather than, the till then thought of HO, refer John Dalton)

1820-22 occupied the chair of mathematical
1834-50 physics at the University of Turin.

Avogadro's number or constant: the specific number of molecules in one mole of any substance. Its value is 6.02252×10^{23}

Mole: The SI base unit of amount of substance that contains as many elementary entities as there are atoms in 0.012 kilogram of Carbon^{12} – ie., in 12g of carbon 12. The elementary entities may be atoms, molecules, ions, electrons, photons, etc. One mole contains 6.02252×10^{23} entities.

Molecule: A single atom or group of atoms joined by chemical bonds. It is the smallest unit of a chemical compound that can have an independent existence.

Avogadro's law/hypothesis was virtually ignored by chemists in 1811 but in 1858 Cannizzaro, a fellow Italian scientist and contemporary of Avogadro defined it further and made it scientific.

He died at the age of eighty. The 100th anniversary of the publication of Avogadro's Law was celebrated in Turin, Italy in the year 1911, which ranked as a world event.

Postscript

Molecular biology: Biology is the science of living things. Molecular biology is the study of molecules involved in life functions, the probe of the problem at its grass-root level, viz, molecule– to qute an instance, Deoxyribonucleic acid (DNA) is an example of a self-replicating molecule which is found in the chromosomes of all higher organisms; attempts to replicate DNA molecules, *in vivo,* include cloning, recombinant technology.

Molecular biology is the promising field for future research.

Why not the younger generation produce "a Watt, a Davy or a Faraday" ?

SIR HUMPHRY DAVY

Sir Humphry Davy (1778 to 1829) a semi-centenarian, father of electro-chemistry was born in December 1778 in Penzance, Cornwall.

After completion of schooling he was apprenticed as a pharmacist; the apothecary and its library gave him good foundation.

Highlights of his career

His scientific career began in 1797.

1. At his age of 20, Davy was in charge of Medical Pneumatic institution and began investigating the medicinal properties of gases.

2. In 1799 this self-taught scientist discovered the "happy and drunk" effect of nitrous oxide on the human system. It made the body immune to pain. It had an euphoric effect and made Davy hysterical in the beginning; after inhaling for some more time, he felt a laughing sensation –hence the name "laughing gas" was given to it. In the year 1800 while lectur-

ing,Davy made some people from the audience inhale the gas and feel pleasant. It was used to control and console quarrelsome wives.In 1844 an American dentist, Horace Wells used it on himself prior to extraction of tooth. Even today this gas is used to induce anaesthesia.

1801 Lecturer, Royal Institution.

1802 Professor in the Institution.

3. He also gave an account of nearly fatal inhalation of "water gas"— a mixture of hydrogen and carbon monoxide.

4. For the next ten years he specialised in agricultural chemistry and chemical fertilizers. He did research on tanning and Voltaic cells.

5. In 1807 he isolated sodium and potassium through electrolysis. As a matter of fact, Davy used his electro-chemical method to isolate magnesium, strontium, calcium, chlorine and barium. This discovery and his first Bakerian lecture won him a prize from the Emperor Napolean, although France and England were at war and logger-heads. In 1812 he was knighted.

6. Some streets are lighted with yellow coloured lamps that contain sodium vapour— this colour is seen in contrast to the pure ivory white colour of a tube-light.

7. As a bye-product of his experiments, Davy discovered the arc light which he demonstrated in 1809. Years later, car-

bon arc lamps were used in military searchlights as well as street lighting.

8. In 1813 he resigned from the Royal Institution and went on a tour of the world accompanied by his wife and young Michael Faraday who became his disciple. Later Faraday emerged as another "giant of science".

9. Davy and Faraday proved that diamond is a form of carbon. A research paper entitled "Eléments of Chemical Philosophy" was published by them.

10. Davy conducted work on volcanic action and corrosion of copper in salt water.

11. On his return to England in 1815 he invented a safety lamp for miners by wrapping the lantern flame in a metal gauze. This gave him the zenith of his fame.

12. In 1818 he was made a baronet of England.

13. In 1820 the crowning scientific honour of recognition of his talent was bestowed when he was elected President of the Royal Society of London. He was erratic, tactless and irritating in his behaviour; he was 'mercurial' in temperament.

14. Davy was a poet, too. Samuel Taylor Coleridge commented thus, "If he were not the first chemist he would have been the first poet of his age."

He died in 1829 at his age of fifty. Because of his work in electro-chemistry, industries worth billions of dollars are thriving!

The discoverer of the doctor's garland

RENE THEOPHILE HYACINTHE LAENNEC

Rene Theophile Hyacinthe Laennec (1781 to 1826), French physician was born in 1781 in Britany. He received his medical education in Paris, served in hospitals therein.

He devised an ingenious method to listen to the heart sounds in a young woman. The method of putting his ear on to the chest wall, would be embarrassing and jeopardising her modesty. He took a sheet of thick paper, rolled it into a cylinder, applied one end over the precordium (region over the heart) and the other to his ear. Enamoured by the clarity with which the sounds were heard, he began devising wooden cylinders which he named as stethoscopes. Thus the present day ornamental garland of the doctor hung round his neck, had its modest beginnings at the beginning of the 19th century.

Laennec listened to the sounds of air entering and leaving the lungs, which are named as 'breath sounds'. He described egophony, a sound resembling the bleating of a goat. He familiarized himself with the normal sounds of the heart; abnormal sounds secondary to diseases of heart valves were described by Laennec, and later verified by post-mortem exami-

nation. In 1819 he published his book on auscultation, i.e., listening to the sounds made by the heart and lungs, by the contracting muscles, by the rush of blood in aneurysms, intestinal sounds, crepitus over a fractured site in a bone, by the foetus *in utero*, or to in any sounds produced in the skeleton or in any internal part in the body. In antenatal care and during delivery, foetal heart sounds are heard through foetoscope, a type of stethoscope.

He was an illustrious, instructive and popular speaker in all branches of medicine. A type of cirrhosis of liver (hardening of the substance of the liver) bears his name—Laennec's cirrhosis.

He used to treat the poor free; he was very considerate to the economically handicapped class. He used to work to the point of exhaustion. Under the stress of fatigue, he developed tuberculosis; thus the discoverer of the stethoscope was a consumptive himself. Tuberculosis affects men of talents and those having a taste for fine arts, poets, artists, etc. He died at the age of 45. Those whom gods love die young. Good men must die; but death cannot kill their names.

In the portrait of Laennec, we see a Parisian (native of Paris) devoid of the paraphernalia of a physician in those days, viz., wig, special apron or any mode of dress reminiscent of the pre-Victorian era.

The clinical examination in every patient in medicine or surgery consists of inspection, palpation, percussion and aus-

cultation.

An observation

His name includes hyacinth, a plant with sweet-smelling bell-shaped flowers, indicating the sweet temperament of the person. More so, tubercle bacilli were attracted by this sweetness in him.

Ohm – the 'Om' of electricity

OHM, GEORG SIMON

Ohm, Georg Simon (1789 to 1854) German physicist was born in Bavaria, son of a locksmith and gunsmith.

In 1811 he received his doctorate in mathematics. At the age of 30 he joined the Jesuit College at Cologne as professor of mathematics, but his contribution to electrical science was not recognised. In 1827 he contributed Ohm's Law which states that the current flow through a conductor is directly proportional to the potential difference, i.e., voltage, and inversely proportional to the resistance. $I = V/R$

$V = IR$ for both alternating (AC) and direct (DC) currents

V(volts) I(amperes) R(resistance in ohms)

amperes = volts/ohms.

Figurative comment : This is almost true in every day life – the more difficult a job is to do, the greater the effort we have to exert to overcome the resistance, in order to get it done.

When a steady current of 1 ampere flowing through a conductor produces a potential difference of 1 volt, the resistance of the conductor is 1 ohm.

In 1833 he joined the Polytechnic School, Nurnberg as a teacher. In recognition of his work, Royal Society of London awarded a gold medal in 1843.

For most of his life, Ohm had a meagre living, poorly paid jobs. In 1852, however, he was catapulted to occupy the chair of physics at the University of Munich. He died in 1854.

In 1881, at the meeting of the International Congress of Electrical Engineers at Paris, it was decided that the physical unit measuring electrical resistance was to be named as 'Ohm', an immortal achievement of the crowning glory, though post-humous, of course, for Georg Simon Ohm.

Ohmmeter: an instrument for measuring electrical resistance which is recorded in ohms.

The unit of conductance is mho (reverse of ohm); now siemen.

Evolution of ohm

1827: 1 ohm = 1 volt/1 ampere.

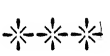
1893: expressed as the resistance of a standard column of mercury. (Ref : Encyclopedia Microsoft Book shelf '95)

1948: absolute ohm defined in terms of the wave impedance in a vacuum.

An observation – No match for glorious past

The three fundamental units of electricity, the ampere, the

volt, and ohm are named after an international trio of scientists – Ampere, a Frenchman; Volta, an Italian and Ohm, a German; – a credit to Europe! Europe gave us light in the night, might in the machine and cool comfort.



Far-a -day with electricity, a city which is not a dwelling place

MICHAEL FARADAY

Michael Faraday (1791 to 1867), the 'father of the electric motor and the electric generator', English physicist and chemist did pioneering experiments in electricity and magnetism.

At the age of 14 he was forced to accept a job as book-seller and book-binder when the lad became a self-educated, self-tutored devotee of science.

In 1810 attended a course in natural philosophy.

At the age of 21 he conducted experiments on chemical and electrochemical lines; he made a Voltaic pile and decomposed compounds with electricity. He took notes from lectures of Sir Humphry Davy, whom he impressed greatly. Faraday accompanied Davy in his continental scientific tour, assisting him in lectures and demonstrations in 1813-1815.

1. In 1821 Faraday devised a primitive model of an electric motor.

2. 1821 he married Sarah Bernard.

3. 1823 liquefied chlorine.

4. 1825 isolated benzene.

5. 1831 He was able to show to the world how to "convert magnetism into electricity". Faraday's law of induction: Quantitative expression of electromagnetic activity— this idea gave birth to dynamo, generator.

Principle of electric induction

Electricity could produce magnetism. Could magnetism produce electricity? How?

Faraday's experiment: Copper wire 220 feet long was wound on a cardboard cylinder, insulating twine and calico cloth in between the turns. A bar magnet was thrust into the cylinder – galvanometer showed presence of current, shift of needle. When the magnet was pulled out, the needle turned to the opposite direction, i.e., stationary position.

Next he moved the coil keeping the magnet still – again success.

So relative motion between the coil (conduction) and magnet would convert magnetism into electricity.

One anecdote in Faraday's life:

He demostrated his above experiment on electromagnetic induction before a huge audience. A lady with a young baby was one of the spectators. The lady became angry. She said, "Is this an experiment? Have you called people to befool them?" Faraday replied.politely, "Madam, just as your child is quite young, so is the case with my experiment. So far, it is like a baby. In future, it may be of utmost importance."

6. Faraday's Laws of Electrolysis (i) Electricity could break down (lyse) water into hydrogen and oxygen.

(ii) Electricity decomposed potassium hydroxide (the chemical name for caustic potash). Thus potassium was discovered. The technical terms used in electrolysis, viz., electrode, anode, cathode, electrolyte, ions were coined by Faraday.

Many metals were commercially prepared by the technique of electrolysis.

7.He showed that magnetic field will rotate the plane of polarization (vibration) of light— Faraday effect; this occurs in many solids, liquids and gases.

8. He studied dielectrics (non-conducting materials of electricity).

9. Lines of magnetic force as described by him — a catch word in modern physics.

According to him, electricity is one of the manifestations in the forces of Nature which included heat, light, magnetism and chemical affinity.

Sir Humphry Davy said in appreciation of Faraday's talents, "The greatest of my discoveries is Faraday."

A boon 'par excellence' to combat the terror of surgery

WILLIAM THOMAS GREEN MORTON

He was a pupil of Horace Wells; he practised dentistry in Boston. The man Morton was a genuine explorer of 'anaesthesia' (from the Greek words meaning 'absence of sensation'), an indomitable Yankee of the 19th century.

Making patients unconscious for surgery, is a great achievement in the history of medical science.

On the suggestion of Dr.Charles Jackson, his teacher, Morton undertook experiments on animals giving ether to them. On one occasion he himself inhaled ether to the stage of unconsciousness. He extracted a tooth under ether anesthesia.

On October 16, 1846 Morton gave a public demonstration of a tumour removed by Dr. Warren without any discomfort to the patient, after anesthetizing him with ether. October 16 is celebrated as 'Anaesthesia Day' or 'Ether Day' all over the world.

The anesthetic properties of chloroform were discovered by a Scotchman, Sir James Y.Simpson on Nov 4, 1847. Because of the pleasing sweet odour, quick induction, quicker recovery from anesthesia, it was preferred to ether. The patient was asked to count, " 1, 2, 3, ...20, 21,.....40,41,..... like that," as the drops of chloroform were put on the nose mask. On an average, a patient used to get anesthesized in a minute or two. But due to the fatal complication of cardiac

arrest, it fell into disrepute. Sir James Simpson was an obstetrician. Theologists from Church raised objection, saying that child birth was a part of the "primeval curse on women". Simpson debated extensively and won the argument by quoting the second chapter of *Genesis*,— "before the Maker of the Universe took a rib from Adam for the creation of Eve, He caused a deep sleep to fall on Adam."

The discovery of cocaine by Carl Koller in 1884 added a new dimension in anesthesiology. The application of, or injection of cocaine, is termed as 'local anesthesia'. When a region, say a hand or finger is anesthesized, it is called 'regional anesthesia'.

As legend goes, August Bier, a German Surgeon injected cocaine into his own spinal canal; the lower half of the body below the level of the umbilicus became insensitive to pain. This technique is termed 'spinal anesthesia'.

Newer drugs like halothane, an inhalation anesthetic are popular now-a-days.

A naturalist at his best

CHARLES DARWIN

Charles Darwin (1809 to 1882), one of the foremost naturalists was rebuked by his father, "You care for nothing but dogs, shooting and rat-catching. You will be a disgrace to yourself and all your family", not knowing that Darwin would one day produce monumental work on evolution.

Darwin was born on February 12 in 1809 in Shrewsbury, England on the same day as Abraham Lincoln was born. He entered medical school but got disgusted with operations performed without anesthesia, hence left medical studies. He received B.A. degree in 1831. He embarked on a 5-year voyage on the H.M.S.*Beagle*, which was a turning point in his life to become a naturalist.

Before Darwin's time, it was held that each species of life on earth made its appearance separately, and that none had ever changed its form. Darwin disproved this and postulated that all living things on earth have descended from common

ancestors, and evolved over millions of years. He propounded the theory that species evolve from other species. All living beings (plants and animals) have evolved in an orderly way; not only that, they continue to change.

Darwin had keen powers of observation. The voyage on H.M.S.*Beagle* was full of adventure. He collected plants, rocks, insects, animals and fossils for study. He interviewed civilized American beautiful ladies called by him as "nice round mermaids", and in contrast uncivilized savages from islands.

The strange iguana (lizard family), the tortoises and the finches (bird family) on the Calapagas Islands in the Pacific, attracted his attention first. He was puzzled to note that similar, yet quite different, forms of the same animals appeared in different islands. This observation gave a clue to his theory of evolution. In the case of evolution in man, the ancestor species was a figure common to himself and the ape.

Why living things change from generation to generation? Human population tended to grow (increase) faster than the food supply available. This increase triggered the struggle for food and thereby a struggle for existence. As far as animals are concerned, man tries to reproduce species of animals with selected coveted qualities (e.g., Ongole bull). In the case of wild animals , those most capable of obtaining food would survive—"Survival of the fittest" theory.

In the struggle for existence, Darwin declared, "Favourable variations would tend to be preserved and unfavourable ones

to be destoryed. The result of this would be the formation of new species."

In 1839 he married his cousin, Emma Wedgewood; he was admitted to the Royal Society the same year. With symptoms of intestinal trouble and fatigue, he was dubbed as a hypochondriac.

In 1859 he published his famous book, the cream of his work, *'The Origin of Species by Natural Selection '* and *'The Descent of Man'* in 1971. In the struggle for life, only the 'fittest' beings would survive and the others would die out. "Humans are one species among many that had evolved from a more primitive one ." Controversies raged over this thought amongst the elite, created furor amongst his colleague scientists and posed a challenge to orthodoxy amongst the churchmen.

Geology

He formulated the theory of coral reef formation in the layers of earth. He studied the processes how volcanoes and earthquakes are caused.

Study of plants : his books

Insectivorous plants

The Power of Movement in Plants.

Zoology : In the book *The Formation of Vegetable Mould through the Action of Worms,* he made out the point that earthworms enrich and aerate the soil, thus making it more fertile–

an ecological equation benefiting agriculture.

Darwinism : Species evolve from more primitive species through the process of natural selection, which occurs spontaneously in nature.

Darwin died at the age of 74; he was buried in Westminster Abbey near the tomb of Sir Issac Newton. Four of his ten children inherited father's glory by becoming Fellows of Royal Society.

Darwin was actually a 'Dare win' in the pursuit of the Theory of Evolution.

Personification of the melody in nursing

FLORENCE NIGHTINGALE

Florence Nightingale (1820-1910), English nursing pioneer. "The Lady of the Lamp" – a name by which she became immortal.

Florence Nightingale was born in Florence, Italy on May 12,1820.

She wanted to achieve something great on secular but not on religious lines. Traits of Florence Nightingale:

1. Personal charm. 2. Culture.

3. Attractive appearance and looks.

4. Deep sincerity in action.

5. Humanitarian impulse.

Till the time she entered the noble nursing profession, nurses were ranked as vulgar creatures, uneducated, unclean, unpolished in behaviour and notorious for their drunkenness and immorality.

Florence took up a challenge to erase this stigma in the public mind and cleanse this ignominious opinion about a nurse.

She developed the British army hospital at Scutari in Tur-

key during the Crimean War (1854-1856). She came to be known as "Lady-in-Chief" by the wounded soldiers.

She founded a nursing school at St. Thomas's Hospital, London.

Modern nursing and patient care are the fruits of her labour. She earned respect for the nursing profession. She worked in "a pure spirit of duty towards God and compassion for man".

Outcry of this young woman:"In my thirty first year," she wrote in her diary, "I see nothing desirable but death." — so disgusted was she about the ways in the world in treating the sick.

She observed these principles in nursing:

1. Cleanliness. 2. Fresh air —windows to be kept open.

3. Hygienic surroundings.

4. Compassion and care. The cure of a patient lies in the care bestowed.

5. Devoted attention to the sick.

In 1907 she was given the Order of Merit, the first woman to receive such a prestigious honour. In the next year, the Freedom of the City of London was bestowed upon her. She lived to a ripe age of over ninety.

Florence Nightingale's prophetic words still apply today, nearly 135 years after they were first uttered in 1863. She had said then, "As a general rule, the poor would recover very well in their own miserable stinging dwellings if they received

proper and efficient medical aid."

In the past, bed rest in sanatorium or hospital used to be considered vital to TB treatment. A major study in Madras showed that chemotherapy was just as successful at home as at hospital. In other words, there is no difference between hospital and home management.

From the time of Florence Nightingale, we now come to the age of Mother Teresa, the noblest of the noble in caring for the sick.

Finally, mention has to be made of the robot nurse who began working in a London Hospital; she does'nt take day-off, works 24 hours a day – plus points to score over a living human-frame.

A multi - faceted intellect

HELMHOLTZ HERMANN VON

Helmholtz Hermann von(1821 to 1894) – original name Hermann Ludwig Ferdinand Helmholtz, German Scientist and philosopher, wellversed and versatile in physiology, optics, electrodynamics, mathematics and meteorology.

In 1843 he graduated from the Friedrich Wilhelm Medical Institute, Berlin.

1849 Professor of Physiology, Konigsberg.

1855 Professor of Physiology, Bonn.

1858 Professor of Physiology and Anatomy, Bonn.

1871 Professor of Physics, University of Berlin.

1888 Director, Physico-technical Institute, Berlin.

His works

1. *On the Sensations of Tone as a Physiological Basis for the Theory of Music* (1875).

2. *3-volume Hand book of Physiological Optics* (1867).

3. He wrote on philosophical and aesthetic problems.

He made the statement of the law of conservation of energy.

His discoveries include:

* Transmission of nerve impulse and the measurement of its velocity.

* Study of wave motion in sound.

* A theory of musical harmony.

* A theory of colour vision.

* Invention of ophthalmoscope, an instrument to view the interior of the eye.

Might of a microscopic cell

RUDOLF VIRCHOW

Rudolf Virchow (1821 to 1902), German scientist Pathologist was born in 1821.

Vegetable cell was discovered by Schleiden and animal cell by Schwann. Virchow adopted these discoveries to his study of human anatomy and pathology.

The cell as the ultimate subdivision of a living tissue was highlighted by him in his aphorism *Omnis cellula e cellula.*

In 1843 he graduated from medical college and became a professor in a Berlin Hospital. In 1849-1856 he was professor of pathological anatomy in Bavaria. In view of his brilliant work and publications , he was recalled to Berlin in 1856 where he remained as Professor of Pathology until his death in 1902. In 1858 he published his book on Cellular Pathology.

He evolved a new sewerage system for Berlin which won accolades for him world-wide.

In inflammations and other pathological conditions, it is the cell that bears the brunt. Thus Virchow struck his note the grass-root level.

He formulated the idea that phlebitis (inflammation of blood vessels) would trigger formation of small thrombi which could be carried in the circulation to distant parts of the body. The same migration of the cells of tumours could explain the metastases of malignant growths/tumours.

The formation of tubercles in tuberculosis postulated by Virchow, even before the discovery of the tubercle bacilli by Koch, could be attributed to dissemination of cells. Though the process of TB is not as deadly as cancer, yet the postulation of the resemblance to cancerous cell embolization is not out of place, in the context of the explanation about the spread of TB in the body. Perhaps TB could well be ranked as a stage in between chronic inflammation and malignancy.

In 1897, at his age of 76, Virchow communicated to the Medical Congress in Moscow his theory of the 'continuity of life'. Any disease or new growth could occur only as an offshoot activity of a previous cell. He endorsed the theory of Charles Darwin which also appealed about the continuity of the life of the cell.

He proved that microscopy is the only means of describing the details of a cell. Just before his death in 1902, a Municipal Hospital was named after him.

Virchow led a life of virtue.

"I am utterly convinced that Science and Peace will triumph over Ignorance and War;..."

—Louis Pasteur

LOUIS PASTEUR

Louis Pasteur (1822 to 1895) French Chemist, France's most reputed scientist, propounded the theory that germs existed and caused infection (disease). 'Health begins where germs end'.

The English equivalent of "Pasteur" is "Shepherd"; "Louis" was the traditional dynasty-based name of Bourbon Kings of France. He was a peasant from the mountains, and he was a traditional Royal-styled Frenchman, thus justifying his name.

At the age of 15 he developed an inclination to drawing – Keen observation involved in it. He wanted to become a panter

At the age of 20 he wrote to his sister thus, "These three things —will, work and success divide between themselves all human existence." It indicates his grit and tenacity.

His interest in the study of crystals of tartaric acid was a prologue to his work on microbes.

Grape pulp changing into alcohol, wine becoming sour – these problems created stir in the mind of Louis ; the former was due to fermentation by yeast, a type of animalcule which was also essential for the conversion of grape juice into wine. Another type of animalcule was responsible for turning the wine sour.

Creation of life : Theories prevailing then: 1. Spontaneous Creation of Life: Church was in favour of this since God created Adam and Eve. Whenever they thought of "Life", they thought of God. Although young Pasteur was not an atheist, he refuted this idea. Maggots are seen crawling out of putrified matter.

2. Life came only from life. Pasteur had clung to this view. One experiment : He put easily putrescible matter, such as meat, into a closely stoppered glass vessel and heated it to kill any living matter that might have existed. No animalcules were found in this sterilized state. But when dust and air were allowed inside, animalcules began to appear after some time. In these experiments, deadly accuracy and triumphant clearness could not be questioned. The animalcules came from the air and dust. Clearly, the atmospheric air contained particles of dust. Might it not contain living cells? These cells, otherwise called "germs of life" are responsible for the animalcules. Thus life emanated from life (living cells). Howelse could life "generate" inside the closed space of the glass vessel?

wise called "germs of life" are responsible for the animalcules. Thus life emanated from life (living cells). Howelse could life "generate" inside the closed space of the glass vessel?

Not only that – a step ahead – Pasteur had the courage to announce that putrescence in his experimental glass vessel could be compared to a similar change in the organs of the hospital patient! – see how the research jump was going up step by step. It is easy for us now to see the microbe in microbiology under the microscope. But imagine how arduous it was for Louis to establish that view, amidst vehement opposition from his contemporaries. It is a fact now. But it was a challenge then.

Lord Lister, British surgeon got inspiration from Pasteur's work and introduced the revolutionary antiseptic system.

Pasteurization : When wine was heated, the animalcules died indeed, but the taste of wine turned bitter after cooling. Suddenly a flash of thought struck his mind to evolve an optimum temperature at which the germs could be killed without affecting the taste; this temperature was 55° C. The wine industry rejoiced at this discovery. Today, the procedure of pasteurization is adopted for milk to sterilize it of germs without altering its flavour.

Still Pasteur had to face the cudgel of criticism, and ridicule because he was a chemist, not a biologist to talk about life. Biologists called him a baffoon. To generalise, such was the fate of every scientist.

He discovered an inoculation against a dreaded disease, anthrax. He did work on rabies/ hydrophobia, a deadly disease caused by the bite of a rabid dog.

The Pasteur Institute at Paris built in his honour stands as a fitting monument to this stalwart scientist. Pasteur Institute in Coonoor, India is another feather in his cap.

Antisepsis for reduction of human misery

LISTER JOSEPH

Lister Joseph (1827 to 1912), Father of Modern Surgery, British Surgeon and discoverer of the use of antiseptics was born in Upton, Essex on April 5, 1827; renowned for his establishment of antiseptic methods in surgery and the use of antiseptics in the operation theatre.

Antisepsis is prevention of infection by micro-organisms by inhibiting the growth of such infectious agents. Antiseptic is a substance capable of achieving antisepsis.

He introduced the method of antiseptic surgery in a London Hospital in 1867. He worked as Professor of Surgery at Glasgow.

Before 1860s many people used to die of wound infection after trauma (injury), surgical operation, etc.

A sufficiently dilute solution of carbolic acid would kill germs but not harm tissues in the human body. So, as a ritual, he began treating everything with weak carbolic acid solution. Operations were performed under a spray of diluted carbolic

acid. Lister began dipping bandages and ligatures used in surgery in this solution. Instruments were dipped in carbolic acid; acid was poured into wounds, gauze was similarly treated. Gradually he noticed a decline in the cases of infection.

He introduced a method of draining abscesses using a rubber tube in the abscess, for flow of secretions.

Thus Joseph Lister gradually revolutionalised the concepts of asepsis with his theory of antiseptic technique. He applied Louis Pasteur's germ theory. He concluded that micro-organisms caused infection of wounds.

Notwithstanding the teething troubles in convincing people on a discovery, he put forth his views vehemently. His article, "On the Antiseptic Principle in the Practice of Surgery" (1867), however, was not initially accepted in England or the United States.

Opposition to the views of a discoverer is not unusual to be vehement in the beginning, but gradually with passage of time truth is established. Truth triumphs.

No less a person of eminence than Queen Victoria underwent surgery in the hands of Lister.

He was the President of Royal Society from 1895 to 1900, and was one of the first 12 members of the Order of Merit. He was made a baron by Queen Victoria. Mr. Lister became Lord Lister.

Lord Lister died on February 10, 1912. Lister listed the antiseptic in medical literature.

Doctors who qualify for FRCS (Fellow of Royal College of Surgeons) sign in the register wherein Joseph Lister was one of the signatories —a privilege bonanza for a surgeon.

So noble was Nobel

ALFRED BERNHARD NOBEL

Alfred Bernhard Nobel (1833 to 1898): Swedish scientist, invented dynamite. Born in Stockholm, ('home, Stock' of Nobel Prizes) he founded the famous Nobel Prizes.

Nobel Prizes are the world's most coveted awards given every year to persons of outstanding merit by way of contribution to knowledge in six fields, viz., physics, chemistry, literature, physiology or medicine, peace and economics. The receipient may be one or more.

Nobel Prizes funded by its founder, Alfred Nobel, were started in 1901. He left huge fortune earned in his life time. This is a fitting gesture of "Respect to Goddess of Knowledge".

He and his father started a small workshop in 1864 for producing nitroglycerine. They faced many problems. The factory was wrecked by an explosion, killing five persons. Nobel was branded a 'mad scientist'.

The honeymoon phase of his venture took shape in establishment of factories dealing with dangerous nitroglycerine.

Hardships were encountered; factories in Germany, San Francisco, New York and Australia were all blown up.

He was a multilinguist fluent in Swedish, English, French, German and Russian. Basically he was a chemist.

This multilinguist became a multimillionaire by selling dynamite and ballistite (smokeless nitroglycerine powder– gunpowder) for which he obtained patent rights.

In 1866, luck favoured him. A chance observation that nitroglycerine packed in an absorbent substance called kieselguhr (package in the cask containing nitroglycerine) was safer to handle, gave him relief. It would not explode with shocks. This discovery was called 'dynamite' which could be exploded by a trigger at the command of the user.

From then on, the fortune of Nobel began shooting up. Fame, name and wealth wooed him.

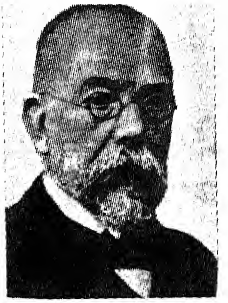
An institution in Sweden– Nobel Institute was named after him.

Nobel Prize has made his name immortal in the world.

Koch is really our medical Galileo,

— Osler (1921)

ROBERT KOCH (1843-1910)



Robert Koch was born on 11th December, 1843 in Clausthal, a village in the mountaneous terrain of Harz in the State of Hannover. He was the son of a miner and was one of 13 in the family. The family of the scientist was set in rural surroundings, with hand to mouth existence. His boyhood days were spent in an atmosphere of poverty, struggle and hope – all mingled in mixed proportions, yet with a happy turnover, on the overall. He had his schooling at Gottingen where he studied mathematics and natural sciences. Subsequently he became a pupil of Henle (1809-85).

Koch qualified for M.D. *cum extreme lauda* in 1866 at the age of 23, the laudable qualification hearalding the future genius in him. He studied under the famous Rudolf Ludwig Karl Virchow (1821-1902), the renowned pathologist of his times. He settled in practice in his rural surroundings after his qualification. He volunteered to serve in his country's army in 1870 but was rejected because of defective eyesight, but his

tenacity of purpose made him pursue military service at a later date. He was highly patriotic in his views and was greatly enthusiastic about the then German Victory; he was harbouring pungent anti-French feelings (loc.cit).

He obtained Diploma in Public Health in 1872. His wife (first one) by name Emmy Fratz who herself was a keen naturalist, presented him with a microscope on his birthday. From his younger days he showed a strong passion for scientific research. The seeds of the ' would-be' genius were planted in right earnest. In 1876 he made the epoch-making discovery of anthrax bacilli, their sporulation, life cycle etc., after examining numerous samples of infected material, skin and hides, meat, etc. His colleagues in this study were Julius Fredrich Cohnheim (1839-84) and Carl Weigert (1840-1904). He consulted the renowned botanist of his times, F.Cohn and got it approved by him. He was doing animal experiments on mice infected with anthrax; examined their blood and other tissues.

By 1877 Koch developed techniques of fixing smears, staining for bacteria and invented the hanging drop method of observing micro-organisms. He demonstrated strepto - and staphylo-cocci as causes of wound infections in 1878. He was appointed in the Imperial Health Office in Berlin in 1880. He demonstrated his solid media for the first time in the first International Medical Conference in 1881.

Louis Pasteur who was 20 years older than Robert Koch

praised him, "C'est un grand progress," though Koch harboured animosity with his in-born anti-French feelings towards Pasteur (loc.cit).

In the epidemiology of tuberculosis, Koch was distressed to observe the worldwide ravages of the disease. As the situation was expressed in those times, one in seven used to die of tuberculosis on a world average; in 1840s one in four were succumbing to the disease in France. Koch was perturbed as well as stimulated by this horrid scene and was incessantly on the search for the causative agent of tuberculosis. Till then, undernutrition, overcrowding, belief in mysticism, etc., were supposed to be factors incriminated in the outcome of tuberculosis.

On one fine morning on 24th March, 1882, a memorable day, Robert Koch demonstrated tubercle baccilli in infected tissue (not in sputum, of course). He published his paper 'Die Aetiologie der Tuberkulose' in 1882, which attracted the admiration of Virchow. He proclaimed the exciting cause of a formidable disease, tuberculosis, to the Berlin Physiological Society and in turn, to the entire world. He was able to prove that consumption (phthisis; TB of lungs) was not, as had been widely supposed, a chronic disorder of nutrition, but an infectious disease that runs a chronic course.

It is pertinent to note that Henle made the predictions in 1840 that micro-organisms are responsible for diseases; they are not visualised not because of their size being infinitesi-

mally small, but because they are embedded in the tissues so inextricably as to become unrecognisable. These predictions were proved by his pupil, Robert Koch 40 years later. It is to be construed as a red letter day in the life-time of Henle to have produced a pupil of such a high eminence, excelling the master.

The following four postulates of Koch followed suit and were widely accepted thenceforth in medical circles.

1. A particular bacillus always causes a particular disease.

2. The micro-organisms must be present in all cases of the disease.

3.They must be cultured artificially on media in the laboratory.

4. Inoculation of these must produce the same disease in susceptible animals. Injection of pure culture into a healthy animal must reproduce the original illness.

Thus the cycle of transmission of the disease is to be completed.

Koch's bacilli, Koch's disease became familiar terms in the medical history of tuberculosis.

Contemporaries of Robert Koch were Carl Joseph Eberth (1836-1926) who demostrated typhoid bacilli, George Gaffky (1850-1918), a military doctor who cultured typhoid baccilli in the year 1884 and Frederich August Johann Loffler (1852-

1915) who discovered glanders bacilli in 1882 and diphtheria bacilli in 1884.

Koch was appointed as Chief of German Cholera Commission in 1883. He spent a considerable part of his life in travel to Egypt and India; isolated cholera vibrio and postulated its transmission through contamination in drinking water. He was awarded national prize of one lakh marks for this venture.

The discovery of Koch-Week's bacillus in 1866 opened the way for understanding the pathogenesis of ophthalmic infections – the so-called "pink eye".

Robert Koch was elevated to the post of Professor of Hygiene and Bacteriology at the Friedrich Wilhelm University in Berlin and Adviser, Imperial Health Office, in 1885. By temperament, he was wholly devoted and dedicated to research. With the constant pursuit of passion towards discoveries and inventions, he added information of immense value for the understanding of communicable diseases which human flesh is heir to. During 1891-1904 he functioned as Director of Institute of Infectious Diseases in Nordufen in Wedding district, North Berlin. Later from 1900-1906 he was also associated with Rudolf Virchow Hospital.

Other illustrious workers associated with Koch were the following:

Emil Adolf von Behring (1854-1917) who discovered

diphtheria antitoxin, a pupil of Koch and became his co-worker. The success of serum treatment of diphtheria was amazing.

Richard Friedrich Johannes Pfeiffer (1858-1945) who did work on influenza bacillus.

William Henry Welch (1850-1934) whose name is associated with gas gangrene bacilli discovered in 1892.

Shibasabura Kitasato (1856-1931), his pupil and later became his fellow-worker, who studied about plague bacilli in 1894.

Paul Ehrlich (1854-1915),the father of modern chemotherapy.

August von Wassermann (1866-1925).

Countless thousands were still dying with the ravages of tuberculosis. Koch's discovery of old tuberculin following his discovery of the tubercle bacilli in 1882 was thought to be a miraculous cure. However, hopes failed and frustration filled the void; it looked as though this disappointment was a folly of the scientist. Koch introduced new tuberculin in 1887 with a rejuvenating effect on the enthusiasm dwindled with old tuberculin. Hopes were raised again. The final results were again disappointing. Thus, tuberculin alternately raised and lowered the hopes of the world in trying to conquer the universal scourge of tuberculosis. Alas! tuberculin failed to fulfill expectations which were prematurely entertained by the enthusiast, Koch. Nevertheless, as a diagnostic test/tool, it has been proved to be of immense value.

The period 1880-1890 turned a dark chapter in Koch's personal life. His family life turned adverse. His wife divorced him. His only daughter did not care for him; Koch became depressed and paranoid. At the age of 50 he married a young actress, Hedwig, consequent on which act he became socially 'persona non grata'. His close relatives and bosom friends deserted him, public furore went to the extent of mutilating the tablet of honour erected in his name in the institute, his house in Clausthal was raided and he was looked down as a social outcaste. Environmental circles criticised him for his remarriage, but Koch exhibited lot of restraint in controlling himself against explosion of emotions and conducted himself with dignity. He remained impervious to criticism amongst his close circles. As a diversion to this unpleasant situation, he took recourse to taking long tours from 1896 onwards, which were doubly beneficial, in the sense that he could forget his family worries as well as pursue his mission of scientific achievements. The zeal of purpose to achieve the goal of advance in research, reigned supreme in his thought.

He went to South Africa to study rinderpest (in cattle). In 1898-99 he toured Italy, Indonesia and New Guinea studying childhood malaria, a protozoan infestation. Koch was obliged to travel far and abroad on useful missions aiming to better the lot of the ailing. During his itinerary he used to give his home address in Berlin and Clausthal – such was his patriotic fervour and love for motherland. In India, he supplemented the work

done by previous pioneers in the field of control of plague. His dynamic presence was noteworthy and praiseworthy when bubonic plague bursted in Bombay round about 1898. He marched to East Africa in 1906 to patiently observe the glossina species in the epidemiology of trypanasomiasis. He established Atoxyl as a cure for the sleeping sickness.

During the sessions in London Tuberculosis Congress in 1900 Koch had the courage to say that bovine tuberculosis was not a problem in humans; he vehemently declared that we have little to fear against bovine tubercle bacilli. The chief foe of man is not the infected cow, but his infected fellow human being. Theobald Smith (1859-1934) was of course, the one who differentiated between bovine and human tubercle bacilli.

A dignified aspect of the personality of Koch is that he is respected not only in his country but all the world over. Figureheads in France acknowledged his worth. He was duly honoured by Kitasato of Japan, his old pupil and associate—a sincere scientist expressing gratitude for the association, and tribute for his excellence. In Tokyo, a Shinto shrine was erected in honour of Koch. Annual tribute is paid till today in commemoration of the splendid soul of R.Koch.

In 1904 at the age of 61 Koch retired from the Institute. Koch was the recipient of Nobel Prize for Medicine in 1905; the title "*Excellenz*" was awarded for his outstanding contribution in tuberculosis.

On 27th May, 1910 his chin dropped and his head was lowered, while sitting in a balcony in a hotel observing a gorgeous sunset. He breathed his last in peace and tranquility without being subjected to any torture in deathbed.

The body was cremated, and the ashes deposited in the institute which he founded. Over the urn is inscribed the inspiring maxim – 'Nunquam otiosus'–meaning, "May it ever animate the workers in science."

In the warfare of man versus microbe, to achieve the welfare of man, we march to battle under the banner of Koch.

"Robert Koch's influence in medicine was surpassed by no man of his century, and equalled only by Lister and Pasteur."

"He invaded continents, not for the conquest of his fellowmen, but to lead the warriors of science against plague and pestilence. He uncovered the source of anthrax and tuberculosis and cholera and Egyptian opthalmia, and gained victories over typhoid and rinderpest and trypanasomiasis. In 1898 when typhoid bacilli proved far more deadly to the American soldiers than Spanish bullets, the mystery about the disease was uncovered by R.Koch."

"Whole empires have flourished and perished without contributing as much to the sum of human knowledge as that one man, reverend Robert Koch."

Startling statistics about TB

Global scenario : TB is the single largest cause of adult

death in the world.

*In 1995, 9 million new cases of TB with 3 million deaths– a death every 10 seconds.

* Reemergence of TB in the West, due to increase in co-morbid HIV infection.

*An estimated 2.3 million died of AIDS in 1997.

*30 million living with HIV in their bodies.

Indian scenario : TB is a public health enemy 'number one'.

*Each untreated case of TB can infect 20 normal individuals.

*Half a million die of it every year, i.e. ' a death a minute'.

Warning signals of pulmonary TB, i.e. TB of lungs

Persistent cough; fever, especially rise of temperature late in the day; sweats accompanying fever during night;

blood-streaked sputum, pain in the chest;

exhaustion, losing weight; loss of appetite and disinclination to work.

TUBER CULOSIS is a

Treacherous disease

Ubiquitous in na ture

Burdening the bread-winner

Erasing his finances and

Remnants in life.

Cruel is its

Unpredictable course

Lurking in the body

Overwhelming its defences

Sure you can conquer

If you make no truce and

Send the germ away.

rays of hope

WILHELM KONRAD ROENTGEN

(1845-1923)

German scientist, A man of 'The German Thoroughness;' Prof. Roentgen discovered X-rays on November 8, 1895. He experimented with the cathode ray tube, by catching the image of bones in his hand on a photographic plate.

He discovered X-rays while studying the phenomenon of fluorescence,a form of luminescence.Fluorescence is the emission of light of certain wavelength [Usually ultra-violet (UV)] when exposed to light of a different, usually of shorter wavelength.

In the room where Roentgen experimented, there was no source of UV light. Therefore, he concluded that the phenomenon of fluorescence involves rays of a new kind. As he was unable to name these rays, he called them X-rays.The X-rays could easily pass through solid structures, thus detailing their texture. The X-rays are electromagnetic waves of extremely short wavelength.

As legend goes, the diamond ring on Mrs.Roentgen's finger was made visible as a shadow in the X-ray photograph.

X-rays are used not only for taking skiagrams of structures in the body but also in treating cancer and other diseases.

Diagnosis-wise, X-ray photograph of lungs to detect diseases, is very popular. X-rays are employed in the detection of stones in kidney, gall bladder. Fractures of bones could be detected. X-rays are also employed to know the structure of crystals, diamonds, etc. They are employed in the screening of radio opaque metallic bodies, for checking baggage in aerodromes. They can also detect cracks in structures (buildings and bridges). CAT scanner (Computerised Axial Tomography) is a sophisticated method of evaluation of bodily disorders and diseases.

Roentgen who received the first Nobel Prize in Physics after its institution in 1901, refused to obtain the patent right for his discovery. He could have become a multi-millionaire by patenting the X-ray idea. He opined that this discovery should benefit entire mankind and should not remain in the grip of a chosen few. He died in abject poverty on February 10, 1923 at Munich. Despite his poverty, he donated the entire Nobel Prize money to the University of Wurtzberg.

Invented a bell to call

ALEXANDER GRAHAM BELL

Alexander Graham Bell (1847 to 1922), the "Father of Telephone" was born in Edinburg, Scotland on March 3, 1847. His two brothers died of TB; dreaded by this disease, the family moved to a safer place, Ontario, Canada. He worked as professor of vocal physiology at Boston University. He taught the deaf to practice speaking. He studied the anatomy and physiology of speech. He was interested in music, too.

Fate ordained Bell to woo the deaf even. He married Mabel Hubbard who was deaf.

In 1875 he discovered the principle of telephone while working on harmonic telegraph. He and his colleague Thomas Watson were experimenting—sending telegraphic signals over one wire at one time. A thought flashed over Bell's mind whether voice could be transmitted over a wire by electrical means. Bell was working on his telegraph receiver in one room while Watson was working on his telegraph transmitter in the adjacent room. After the telegraph signals stopped vibrations in the wire, i.e., during a 'steady state', Watson made some

sounds with his fingers on the wire which were heard by Bell. Astonished by this finding, Bell went running to Watson and revealed this episode. Subsequently more experimentation took place. Graham Bell's first utterance, "Watson, Watson, come here, I want you" – these words remained in history as the genesis of telephone.

In 1876 Bell obtained a patent for his telephone; next year he became a U.S.citizen. He was the founder of an important magazine *Science*. He was made President, National Geographic Society from 1898 to 1904.

Telephone is a boon – gift of science by which we can talk to people thousands of kilometers away from us. Hearing a voice evokes pleasure. It is a link between countries and minds.

In August 1877 a telephone was installed in the House of Commons. In November 1877 a permanent telephone line (wire) was laid in Berlin. Telephone exchanges began springing up world-wide. Bell inaugurated the telephone service between New York and Chicago in 1892. By 1915, a 3400 mile - long cable (bundle of wires) was laid under the sea.

Other achievements of Bell

1. Interest in aviation after 1895.

2. Bell and his group of workers developed 'Hydrofoil', a new form of speed boat in 1919.

The Scottish American scientist was a very polite person.

When he died in 1922 at the age of 75, all telephones in U.S.A. remained silent for one minute, in memory of this inventor of telephone, as a mark of respect to the departed soul.

The word 'Bell' in the name Alexander Graham Bell indicates the ringing bell in the telephone receiver on the arrival of a call– a fac' that he was destined to make this discovery!

In the present day

1. Alexander Graham Bell Association for the Deaf, Washington is existing in America to provide facilities for persons with this handicap.

2. DoT–Department of Telecommunications. I-net (Internet),intranet, satellite working on wireless equipment in contrast to the cable (wire) equipment in Bell's days. The above communication network is expanding now-a-days, on the analogy, the steam engine is replaced by Diesel locomotive.

3. In 1989, Bell Labs develped the modern Digital Cellular Radio Technology.

The physician is the flower (such as it is) of our civilization.

— R.L.Stevenson

SIR WILLIAM OSLER

Sir William Osler (1849 to 1919), one of the most exalted physicians of the 20th Century was born in 1849. He was typifying authorship, medical expertise, humanistic attributes. His humane behavior is a feather in his cap.

His book *Aequanimitas with Other Addresses to Medical Students, Nurses and Practitioners of Medicine* published in 1904 gives an insight into his qualities and conduct during his 70 years of earthly existence. He focussed on two related words— 'imperturbability' and 'Aequanimitas'. He defined imperturbability as 'coolness and presence of mind, calmness amid storm, clearness of judgement, immobility (meaning stability) [and] impassiveness'.

Aequanimitas signifies calmness, patience, kindness, even temper, composure, self-control and impartiality.

In 1872 when his wish to choose a career in Ophthalmology was thwarted, he coolly remarked, 'I accept the inevitable with a good grace.'

The word 'Oslerian' was coined. His reaction to adversity was equanimity. He was, at times, bored with 'the vegeta-

tive life of the work-a-day world'. Osler used to say.' Leave no place for criticism or for a harsh judgement about his brother (i.e. colleague). Osler believed in euthanasia.

The smile on the face of William Osler was proverbial. He wasted no time when seeing patients, as he intensely disliked having to listen to their irrelevant reminiscences.

'He was never anything but courteous and kind to the patients'. He took care 'not to let his judgement become flawed by fraternizing with them, or by overtly exhibiting emotional reactions'.

His sportive spirit at a stressful event is reflected in the following happening. Osler, Wyndham and Winston Churchill contested for the position of Lord Rectorship of Edinburgh University. Wyndham was elected with 826 votes; Churchill got 727; and Osler 614. Osler commented, "An independent has not been elected since Thomas Carlyle in 1865... I am not a Carlyle. I did not expect it."

He maintained emotional equilibrium on the death of Sir Stephen Mackenzie, a good friend of Osler for 36 years.

Osler settled in England in 1905 on appointment as Regius Professor of Medicine at Oxford.

Cushing states," It was not in Osler's nature to worry." In 1910, at the age of 60, he wrote to a friend, 'I am in bed with another attack of renal calculus. This has lasted longer and I have enjoyed the luxury of two hypodermics.'

His view to take the positive effect of illness— '...how often does ill health... concentrate a man's resources and bring

out qualities of work, the fruits of the spirit, which may be missed in the hurly - burly of the work-a-day world.'

One of his major passions was books – and especially older ones. He established Osler Library at Mc Gill University, Montreal.

Osler, being a sensible human being was family - oriented, too. He wrote on his son's death, "And even if I laugh at any mortal thing, it is that I may not weep." Osler lost his buoyancy and gaiety after the death of his son, his only child; he got emaciated and lost much weight. Until his own death, Osler suffered with this emotional wound, grieving overtly and at times covertly, an aching void helpless for him to fill.

Osler managed with his illnesses– angina pectoris, renal calculi and respiratory disease, with equanimity, occasionally with a sprinkling of humour.

Some literary men criticise his Aequanimitas, saying that he ignored to highlight about compassionate behaviour toward the patient; emotionally, benign equanimity is not enough to better doctor-patient relationship. It is true that even Osler himself deviated from his own principle of Aequanimitas in certain instances.

He died in 1919. His peripatetic medical career left a deep imprint in Canada, USA and the UK. He was a native of North America, settled and died in England.

A Soviet look at the trio—physiology, psychology and psychiatry.

PAVLOV IVAN PETROVICH

Pavlov Ivan Petrovich (1849 to 1936), Russian physiologist and experimental psychologist, best known for the discovery of the 'conditioned reflexes', was born in September 1849 .n Ryazan in Russia.

In 1879 he completed his medical course after graduation from the Military Medical Academy; later he spent two years with Karl Ludwig studying the nerves of the heart.

In 1890 he was appointed as Professor of Pharmacology in the Medical Academy; a year later, he became head of the Physiology department at the St. Petersburg Institute of Experimental Method.

Reflex action

A bit of dust elicits sneezing.A particle of food inadvertently entering the wrong way, viz., the windpipe awakens cough, the watch dog of the respiratory tree, to throw it out. You jump when in danger. When a speck of dust gets into the eye, the

eyelids close. All these actions are called reflexes; these occur without the involvement of the will or consciousness.

Ivan chose the dog's stomach for his experiments. The dog's mouth watered not only when given food but also at the sight of food. Pavlov made a guess that this could be due to previous experiences, psychological in mind, not merely physiological.

A further step was the discovery of "conditioning" or "conditioned reflex".

He placed a dog in a small sound-proof room. A bell was rung and the food placed before the dog. Saliva used to flow at such instances. It was noted that saliva dribbled out at the ring of a bell, even when no food was placed! Further, in another experiment it was noted that the dog began salivating at the sight of the experimenter, eventhough meat powder was not brought and put before it!

Pavlov showed the corelation between the nervous system and digestive system; he was awarded the Nobel Prize in 1904 for his work on digestion.

He made a classification of human temperaments, based on his experimental study on neuroses in dogs.

The counterpart of his experimentation on animals (dogs) is an eye- opener scene of such reflexes appearing on the dining table in every-day life, as to how appetite is influenced by the emotional status of the individual – the longing for the husband to be served by his wife, pleasant atmosphere, etc.

'How fickle appetite is !'

Inroads into psychiatry

When a dog is conditioned to a state of confusion, it exhibits nervous breakdown; Pavlov opined that he could decondition the dog to cure it. This will apply to human beings also.

A child may throw temper tantrums when he desires 'attention'; thus the child knows how to condition the parents.

Ivan coined the phrase "higher nervous activity" or behavior. He looked forward to "a legitimate marriage of physiology and psychology".

He became a severe critic of French, German and American schools of psychology including the physiologist Sherrington, for not agreeing with his views.

He died in 1936 having fulfilled his mission in life.

"When he rang the bells for the dogs, he got a response that set psychologists on the path to a new understanding of human behavior."

Alchemist of the Rainbow and discoverer of "Magic Bullet"

PAUL EHRLICH

Paul Ehrlich (1854 to 1915) 'The Father of Chemotherapy' revolutionalised curative medicine.

Definition of chemotherapy: Treatment of infections and diseases by means of chemical substances or drugs.

Ehrlich lived in Silesia in Germany during his boyhood. Later he took Doctorate of Medicine. Right from his childhood he was attracted by colours– he was absorbed in the sight at the rainbow; he had an obsession with colours.

He understood the potential uses of aniline dyes derived from coal tar. Germans captured the world market in those days in the manufacture of organic chemical compounds.

Ehrlich made experiments on staining procedures; he said every tissue of the body, or a bacterium could be stained with dyes. He worked with Karl Weigert, on whose name a stain is existing. Robert Koch discovered tubercle bacilli in 1882; Ehrlich stained them with methylene blue, a stain. Koch was pleased with this attempt; never had the bacilli been revealed so clearly.

Paul Ehrlich was invited to work in the New Robert Koch Institute for Infectious Diseases, where he had opportunity to work with Dr.Emil von Behring who discovered a method of preparing diphtheria antitoxin. Ehrlich increased the potency and efficacy of the antitoxin and in fact saved it from extinction.

A bout with tuberculosis forced Ehrlich to interrupt his work and go to Egypt for a cure. On return to Berlin in 1889, the disease had been permanently arrested.

In 1889 he was appointed in a Research Institute, Royal Prussian Institute for Experimental Therapy.

Ehrlich was dependent on Havanas (a brand of cigars). Sigmund Freud was his contemporary in science as well as in smoking! Cigars and mineral water– these two were his constant companions, they were his meat and drink.

His pockets were full of coloured pencils –red, blue, green, the tools of his experimental research, to draw the findings. He used to sit amidst heaps of journals and scientific papers. He used to mix solutions of different colours in test tubes in his experiments; he was called 'the virtuoso of the test tube'.

Chemicals and diseases

Every cell and tissue in the body, according to Ehrlich, has got chemical loves and hates.

Basis of his research: Some chemical compounds could

be hostile to germs in the body but how to introduce them? The dose has to be determined. The sterilizing substance must be harmful to the parasite/germ but harmless to the tissues.

Atoxyl, a compound containing arsenic has been tried in sleeping sickness. On pursuing the genealogy of atoxyl, i.e., fractionating it, a compound was obtained named 606, viz., the 606th fraction.

In 1905 it came to be known that the notorious disease, syphilis was caused by a corkscrew -shaped spirochaete, stained by a dye containing silver and observed under dark ground illumination. Syphilis was taking a heavy toll of human life. Dr.Hata, a Japanese, working with Ehrlich found that the preparation 606 could halt the process of syphilis in rabbits.

Arsenic is a deadly poison. Even if an infinitesimal portion is introduced in the body, where is the guarantee that it will not accumulate to a fatal concentration later?

People were impatient because patients of syphilis were dying. What if a little risk is taken in fighting such an adversary since animal experiments proved its efficacy. It had to be injected slowly into a vein. The "Magic Bullet" against syphilis has arrived, at last. Demands for the supply of the drug began increasing. The drug was named *Salvarsan* meaning in Latin 'the drug which saves health'.

This was the first service of organic chemistry to medical science, the beginning of chemotherapy.

Later neo-salvarsan, number 914 was introduced; it was less toxic, more easy to manufacture, more easily dissolvable in body tissues.

Ehrlich, the king in the realm of applied chemistry won the Nobel Prize.

Arsenic, Bismuth and Mercury products were weapons against syphilis in early 20th century.'A moment with Venus, lifetime with Mercury' used to be a stinging pun on the poor syphilis patient. Later on and now, Penicillin has come to stay as the drug of choice.

In 1915 diabetes devitalized Ehrlich; there was no treatment except severe restrictions (in diet, life style, etc.)

One substance called sulphanilic acid was taken note of as the ancester of the genealogy of sulphonamides which were curing pneumonias prior to Second World War.

He died in 1915. This versatile genius was praised as an advocate of 'chemical thinking' in medicine and biology – the highest accolade for him.

Psychological Man

— Philip Rieff

FREUD, SIGMUND

Freud,Sigmund (1856 to 1939), Austrian physician neurologist, the creator of psychoanalysis, pioneer in the 20th Century Western theories of child rearing, child education, art, literature and culture was born in 1856 in Czekoslovakia. His parents moved to Vienna at Freud's tender age.

As a boy he was intellectually precocious; his feelings toward his father were ambivalent. However, he had a close attachment to his mother —true to a fortuitous Oedipal tendency which indicated a scientist in the budding, destined to invent the theory of Oedipus complex.

At the age of 8 he began reading Shakespeare. Inspired by the teachings of Goethe, he opted a career in medicine.

1873 Medical student in Vienna.

1882 Served as a doctor in a hospital in Vienna.

1885 Went to Paris to study with Jean-Martin Charcot, Neurologist.

He came to the conclusion that mental disorders might be caused by purely psychological factors rather than by organic brain disease.

He wrote a book, *Studies in Hysteria* (1895). In female hysterics, in the background of a sexual feeling or urge, the psychic defences against it culminate in the bizarre symptomatology of hysteria. In the cure, in contrast to hypnosis, he banked upon patient's cooperation, i.e., "free association", "talking cure" which is the method of psychoanalysis. The patient reveals repressed thoughts and memories, especially sexually oriented ideas.

In 1899 he wrote a book, "*The Interpretation of Dreams* in which he opined that in a dream a wish can be satisfied, by an imaginary fulfillment of the wish.

In 1904 he published *The Psychopathology of Every day Life.*

Studies in Sexology

Sexuality is the prime mover in human behaviour.

Sex implies sharing.

Evolution of sexuality: (sex as an instinct).

1st year of life – Oral phase – infant sucking the breast appreciates mother as the first external object of love.

2nd year – Anal phase – focus shifts to the anus; toilet training – child's pleasure in defecation

3rd phase from 4th to 6th year – phallic phase.

Oedipus complex: the desire of male child to sleep with his mother and remove the obstacle to the realisation of that wish, his father. In the case of a girl, disappointment over the non-existence of a penis, is transcended by the rejection of her mother in favour of a father "figure".

Sexual maturity means heterosexual, procreatively oriented, genitally focussed behaviour. It is a hallmark of health!

Perversions: Sexual perversions are unnatural behavioural acts, eg. incest, i.e., sexual intercourse between brother and sister or father and daughter. As legend goes, Cleopatra used to indulge in this!

Neuroses: Anxiety neurosis, according to Freud is caused by physical suppression of sexual release.

Psychoses: due to redirection of libido back on to the patient's ego.

1909 In his home, Freud organised a forum of psychiatrists; gradually it developed into Vienna Psychoanalytical Association.

In 1910 he wrote a book, *The Origin and Development of Psychoanalysis.*

Freud's so-called metapsychology (=beyond psychology) provides basis for cultural, social, artistic, religious and anthropological phenomena.

Freud was invited to America to give lectures. He was

busy studying the dynamics of the psyche (= mind). He studied the influence of unconscious drives in shaping "behaviour".

Two books were written by him—*Beyond the Pleasure Principle*(1920), *The Ego and the Id* (1923).

Freud's trichotomy

His earlier division of psyche was classified as the unconscious, preconscious and conscious state; subsequent categorisation was 'Id, ego and super ego'.

Gradually Freud's thinking began to change. The original 'libidinal drive' that seeks sexual pleasure has been changed to a 'self-preservation drive' whose object is survival.

In 1914 the term 'narcissism' (=abnormal and excessive love or admiration for oneself) was a variant of the above thought. Eros is a Freudian term, life instinct for survival.

He prepared monographs on aphasia and on infantile cerebral paralysis.

Religion

In his Essay "Obsessive actions and Religious Practices"(1907) and book *The Future of an Illusion* (1927) he observed, "belief in God is a mythic reproduction of the universal state of infantile helplessness. Like an idealized father, God is the projection of childish wishes for an omnipotent protection."

According to the Buddhist thought Nirvana निर्वाण (=salvation) means a peaceful state of the psyche, which is

akin to Freud's concept of control of the mind.

In 1930 he wrote a book, *Civilization and its Discontents;* he was honoured with the Goethe Prize for Literature.

In 1936 elected to the Royal Society.

Freud's final major work, *Moses and Monotheism* (1938).

In 1938 Hitler invaded Austria.

Freud's books– fruits of a "Jewish science" were burned when the Nazis took over Germany. Freud was forced to go into exile. He fled to England.

He suffered from cancer of jaw, secondary to his heavy smoking and underwent 33 surgical operations during 17 years of suffering; yet he remained productive in career during this disease.

Sigmund Freud died in 1939. A plethora of Freudian schools emerged ; his ideas were not buried, of course.

Electron: upon it is based the whole science of electronics

THOMSON, SIR JOSEPH JOHN

Thomson, Sir Joseph John (1856 to 1940) 'the father of the electron' was born in 1856 near Manchester, England.

Joseph John Thomson was an avid voracious reader, a good student, recipient of John Dalton scholarship—the qualities of a future career of teacher in him; coming events portend signals. He completed his engineering course at the age of 19, went to Trinity College on a scholarship where he got second rank in Mathematical Tripos, a competitive examination in Cambridge; MPC - Mathematics, Physics and Chemistry, a famous trio of sciences is respected all over, at all times. He nearly blinded himself in experiments in chemistry.

1. In 1881 he wrote a scientific paper which was a forerunner of the Einstein Theory.

2. In 1884 Professor of Physics, Trinity College.

3. From 1884 Cavendish Professor & Director, Cavendish Research Laboratories for 34 years.

4. He married Miss Rose Paget in 1890.

5. Discovered 'electron' in 1895, revolutionalising the

atomic structure.

Niels Bohr, in his model of the atom, indicated protons in the nucleus and electrons travelling/orbiting around it.

Electron: it has a rest mass of 9.1 x 10 $^{-28}$ gram which is about 0.0005 i.e. 1/2000th of a proton. The electron has a negative charge of electricity. Not all electrons are associated with atoms. Some occur in a free state in a gas (say, atmosphere) or in vacuum. The electron has an anti-matter counterpart called positron with a positive charge; one annihilates the other on contact.

The velocity of the electron is about 1,60,000 miles per second (the velocity of light 1,86,000 miles per second). How to photograph this electron? Charles T.R.Wilson, the student of Thomson came to his rescue, invented a cloud chamber to photograph atomic particles.

Proton: stable subatomic particle with a positive charge. Its mass is 1.67 x 10 $^{-27}$ Kg which is 1,836 times the mass of an electron. In 1920 Ernest Rutherford called hydrogen nucleus as a proton; nitrogen under alpha particle bombardment ejects hydrogen nuclei. Protons are the chief constituents of primary cosmic rays.

Neutron: as the name implies, it has a neutral charge, i.e., zero charge; invented in 1932 by James Chadwick. Its mass is about the same as that of a proton (1840 times that of electron).

Charged particles can be tackled/controlled by magnets or electric fields, but not neutrons.

6. In 1897 he was crowned "the father of the electron". In

the same year, he declared that cathode rays are units of electric current made up of negatively charged particles of subatomic size, viz., electrons. Electronics is the study based on electrons.

7. He was knighted in 1908.

8. Work on isotopes: Isotopes are atoms of the same element which have the same atomic number, same number of protons, but differ in the numbers of neutrons and atomic weight (mass).

Atoms with a net charge are called ions. If a neutral atom loses an electron it becomes a positive ion; if it gains an elec-ron it becomes a negative ion.

Thomson was a highly gifted teacher. No less than eight of his students distinguished themselves as Nobel Prize winners. His son won Nobel Prize for physics.

But for the discovery of the electron by J.J.Thomson, we would not have been in a position to enjoy TV, electronic video games/camera, to use computer, optoelectronic lasers, electron microscope, to invent industrial robots and such umpteen gadgets.

He was accorded the honor of burial in Westminster Abbey in 1940 on his death at a ripe age of 84, a Royal prerogative.

He left a legacy of text books on MPC— mathematics, physics and chemistry, the brilliant trio of basic sciences which makes its students brilliant.

A benefactor of mankind

SIR RONALD ROSS (1857 to 1932)

It is a matter of genuine pride for the people of India and Andhra Pradesh in particular, to honour a Britisher, born on Indian soil – a born genius who made one of the greatest discoveries in the medical history of the world.

Ronald Ross was born in Almora in the Kumaon Hills region of Himalayas in the year 1857. He was a medical doctor - MRCS Member of Royal College of Surgeons, son of Major General Campbell Ross, an Infantry officer in the British Army.

As a youth, Ross had no predilection for medicine but he had to yield to his father's wish to see Ross enter the Indian Medical Service.

He joined I.M.S. (Indian Medical Service) in 1881 in Madras. By nature he was kind-hearted, assiduous and tenacious.

1. First furlough (1888-89): He went to England, took diploma in Tropical Diseases. In London Sir Patrick Manson,

an authority on tropical diseases inspired Ross to unearth the mystery of malaria which was believed to be caused by 'mal air' (bad air). Who knew at that time that this credit would go to this legendary figure, Ross, the benefactor of mankind!

2. He was a poet, painter, musician, soldier, writer, mathematician and medical doctor. He had great praise for Byron.

Poems by Ross

VISION

'The wings of Fancy are but frail,
And Virtue's without Wisdom weak;
Better than Falsehood's flowery vale,
The Truth, however bleak.
Tho' she may bless not nor redeem,
The Truth is true, and reigns supreme.'

LABOURS

The Indian Mother

An Indian mother there,
Young, but so wretched that her staring eyes
Shone like the winter wolf's with ravening glare
Of hunger, struck me. For to much surprise
A three-year child well nourish'd at her breast,

Wither'd with famine, still she fed and press'd –

For she was dying. 'I am too poor', she said,

'To feed him otherwise'; and with a kiss

Fell back and died. And the soul answered,

'In spite of all the gods and prophets– this!'

Bangalore 1890 – 3.

Indian Fevers

The painful faces ask, can we not cure?

We answer, No, not yet; we seek the laws.

O God, reveal thro' all this thing obscure

The unseen, small, but million - murdering cause.

Bangalore 1890 - 3.

In Exile

We live, we learn the wealth

The joyous hours may bring,

But jealous time by stealth

Puts all of it to wing;

World Sorrows

Great East; O aged Mother,

Too old for Fear and Hope –

Fear that is Pleasure's brother,

And Sorrow's sister, Hope–

His mentor Manson suggested that mosquito and malaria go hand in hand – may be (i) drinking water contaminated with mosquitoes gives rise to malaria. (ii) some spores of malaria fever floating in the air lead to malaria, by inhalation. At that age of ignorance and speculation, what a gulf of difference between myth and reality!

3. In Secunderabad in 1893 he participated in a meeting sponsored by Major Edward Lawrie, Principal, Hyderabad Medical School. He was a member of Secunderabad club. He was a good horse polo player. He played tennis in Secunderabad club.

He served in the British Army at many places– Madras, Andaman Islands, Burma, Bangalore, Berhampur, Vizianagaram and Calcutta. He wrote poems, dramas, essays and composed tunes in music. He solved some difficult mathematical problems.

4. Ross devised a hanging microscope on his shoulder to observe the details about the mosquito. He was nick-named as a "Mosquito-man," for his above venture!

He happened to examine mosquito species in Coonoor, a place rampant for malaria; in the bargain Ross himself contracted severe malarial fever. He observed closely "Anopheles" mosquitoes, the species responsible for malaria. His tenacity was to find out the chain of transmission of malaria from mosquito to man.

Experiments done by him

(i) He fed mosquitoes on known malarial patients, powdered the bodies of those mosquitoes , inhaled it as snuff. He did not develop malaria.

(ii) He examined under microscope the water contaminated with the faeces, eggs and larvae of mosquitoes. No micro-objects were seen.

(iii) The water with dead mosquitoes was given to a volunteer (a hospital servant) to drink. He did not suffer from malaria.

Yet the stubborn scientist Ronald Ross would not abandon his experiments. An epoch-making event could dawn one day!

5. He went to England on second furlough (1894). Before the year's leave from 1894 to 1895 was obtained to proceed on furlough, Ross began to consider seriously whether he should change from medicine to literature, profession - wise!

In Britain he discussed with Manson about his experiments. His mentor, Manson encouraged him to continue his research.

6. He returned to Secunderabad in May 1897. He was posted as R.M.O. (Resident Medical Officer) of 19th Madras Infantry station hospital in Secunderabad Cantonment. This reminds one of the dual rule in those days, the Nizam and British Government. His place of work was a humble simple red-

tiled building adjacent to Hyderabad airport. Who ever guessed this structure would be the venue of this epoch-making world-event of the discovery of the malarial parasite!

The "mosquito-man" began work with zeal and renewed vigour, continued weaving his string of experiments.

Twenty mosquitoes were allowed to bite a malarial patient, Hussain, and later they were kept in glass jars. He used to dissect those mosquitoes one or two a day, after completing his routine work. Sweat used to fall on the microscope. He sacrificed the comfort of "punkah" (a type of fan swung by a punkah-puller in those days) since the breeze generated would disturb the dissection. Swarms of flies and fine insects used to enter his eyes and ears; yet perseverance and tenacity (bulldog tenacity, though applied formally to Winston (Churchill) were his weapons – undergoing misery for the would-be benefit of others; that's how he earned the name 'benefactor of mankind'.

His superiors were skeptical about Ross; they thought he was trying to dodge work under the garb of research. Actually Ross was transferred to Secunderabad, a relatively less malaria-infested place from a posting in Assam, an endemic area (of high prevalence) of malaria, so as to thwart his research activities. Ronald's urge for research, however, did not fade away with such tricks of the authorities.

On 20th August, 1897 in the afternoon, he dissected the nineteenth mosquito. Having failed to see any micro-objects,

parasites, he was about to discard that also (*not knowing he was at the threshold of success*!) He ordered for a cup of tea, scanned the dissection again, and found some elevations on the outer wall of the stomach of the mosquito. On splitting open the elevations, he found dark pigmented granules oscillating and hence he inferred that they were not inert bodies but live. A thought flashed in his mind while sipping the tea he had ordered, whether these structures could be a stage in the development of the parasite. He made drawings meticulously and later incorporated them into his book *The Memoirs*. He dissected the twentieth mosquito also and found the same observation. At last, the Angel of Fate blessed him!

Ross wrote in ecstasy a poem:

This day relenting God
Hath placed within my hand
A wondrous thing; and God
Be praised. At his command,
Seeking His secret deeds
with tears and toiling breath,
I find thy cunning seeds,
O million- murdering Death.
I know this little thing
A myriad men will save,
O Death, Where is thy sting?
Thy Victory, O Grave?

He reported his findings to his mentor, Manson in London and forwarded a copy of his notes to Army Medical Corps Headquarters in Calcutta.

7. Ross was very much disgusted with the bad treatment meted out to him by his superiors. He resigned his post of Surgeon -Major in I.M.S. and returned to England in 1899. He joined as a lecturer in Tropical School of Medicine, Liverpool. Nobody would be convinced that mosquitoes cause malaria. His methods of mosquito control practised in Sierra Leone, "White Man's Grave", because of highly infested malaria, brought down the incidence of malaria in that region; mortality came down steeply in the span of one year. Soon the Governments of Italy, Greece, Russia, British Colonies in Africa and Suez Canal zone sought the advice of Ross in malaria control. Ross emphasised that breeding of mosquitoes should not be allowed.

Ross received the Nobel Prize for medicine in 1902, first India-born Britisher to get this coveted honour. Soon he was knighted by the King of England.

The mosquito carries both malaria and yellow fever. Hence attack on mosqsuitoes is a two-pronged health drive.

Ross completed writing his autobiography, *The Memoirs* in 1922. The statement made by Sir Ronald in 1926: "The yearly toll of human lives made by malaria is greater than that of the World War."

Ross died in 1932. The world acclaimed him as the 'benefactor of mankind'.

In 1935 the Cantonment Authority of Secunderabad in-

stalled a marble plaque at the Begumpet hospital where he worked. The inscription on it reads:

In

this building

on

20th August, 1897

The Late

Sir Ronald Ross

a benefactor of mankind

made the great discovery of

the parasites of malaria

in a dissected mosquito

20th August is celebrated as International 'Mosquito Day' all over the world.

The 140th birthday of the Nobel Laureate Sir Ronald Ross was celebrated on May 13, 1997. A sum of rupees 30 lakhs was donated by the British Council for the renovation of the building in Begumpet where Ross discovered the malaria parasite.

On a global scale, malaria still causes death in more than a million people (mostly children) each year with a total of 250 to 450 million clinical cases annually.

Malaria is characterized by the clinical triad—chills, fe-

ver and enlarged spleen. When the episodes recur, anaemia gradually develops.

National Malaria Eradication Programme (NMEP)

Government of India: Preventive measures.

*Screening of windows/doors of the house.

*Proper clothing

*Use of mosquito repellant.

*Use of mosquito net.

*Do not allow water to stagnate in the house or surroundings for more than 7 days.

*Dry your cooler every sunday (complete change of water).

The scientist who gave life to a dumb plant

SIR JAGDISH CHANDRA BOSE

Sir Jagdish Chandra Bose (1858 to 1937), biologist and physicist was born in 1858 in Mymensingh (now in Bangla Desh). He used to read *Mahabharata* and *Ramayana* regularly; Karna was his hero –True success is born out of defeat.

He studied in St.Xavier School, Calcutta, later learnt physics at Calcutta University. Then he obtained B.Sc., Degree from Cambridge University. In 1885 Asst. Professor of Physics in Presidency College, Calcutta.

1894-1902 he studied electromagnetic waves. He designed a sensitive instrument called crescograph to record growth of plants; it would magnify the movement 10,000 times. It was praised in the Paris Congress of Scientists held in 1900.

1895 he hinted a fore-runner idea of Marconi that microwaves are waves of short wavelength; he developed an instrument 'Coherer' for the detection of radio waves. In Town Hall, Calcutta, he demonstrated 'aerial' principle; later developed

into 'antenna'.

In 1897 he got recognition in Britain for his work on electricity. Lord Lister, Lord Kelvin and Sir William Ramsay praised him.

In plants, as in human beings, the plant cells function as brain, muscle and heart. He discovered selenium, germanium in electronic equipment. Bose gave these ideas: Electronic gadgets like radar, missiles and computer are evaluated in physiological terms such as intelligence, memory, receptor, feedback, etc. Computer is a super brain.

Electrical and optical beams are amenable to reflection, refraction and polarization.

Clarke Maxwell declared that light waves are of electromagnetic nature, verified later by Hertz in 1880. Bose says, "electric waves are broken glimpses of invisible light."

Bose believed in molecular strain. In 1899-1904 he said inorganic matter is also subject to fatigue. In this connection, we are reminded of the event of the famous Big Ben clock in London getting into metal fatigue.

In 1901 he proved by an experiment that plants have feelings like human beings, before an august gathering of scientists at the Royal Society in London. The plant died with poisoning by bromide solution when it was dipped into it.

In 1902 he wrote a book, *Response in the Living and Non-living*. Plant behaves like a drunkard when put in alcholic solution. Plants have nerves, react to pain. The leaves and fruits denote expression of joy. George Bernard Shaw, a vegetarian shared the agony of a piece of cabbage showing violent paroxysms when 'being roasted'. Plant cells expand and contract to variations in temperature, following the law 'heat

expands bodies, cold contracts them'. Bose received D.Sc. from London University.

The greatness of Bose lies in his manipulation of experiments in a limited space, say, the area of an optical bench and with limited finances. (*Note*: Sir C.V.Raman also started with an equipment worth Rs.200; discovered Raman Effect) –Humble beginnings leading to splendid results !

In 1920 FRS (Fellow of the Royal Society).

In 1926 he wrote a book, '*The Nervous Mechanism of Plants.*'

During his visit to America a press acclaim – "What is the tale of Alladin and his wonderful lamp compared to Dr.Bose's Crescograph?". The action of fertilizers, foods, electric currents and stimulants can be detected by this instrument in 15 minutes; it records the throbbing pulsations of the telegraph plant and the 'death-recorder' indicating the death-throes of the plant.

Thus Bose gave life to the dumb plant.

He founded Bose Institute in 1917, funded it with donations. He remained Director of the Institute till his death in 1937.

The Statesman wrote, "Jagdish was one of the first Indians whose devotion to science attracted interest in the West."

Ardent longing

Why not find a Jagdish Chandra Bose, Sir Issac Newton, Albert Einstein in the present day younger generation?

The ray of hope for chemists

ACHARYA PRAFULLA CHANDRA RAY

Acharya Prafulla Chandra Ray (1861 to 1944) was born in 1861 in a village in Khulna (now in Bangla Desh), 'Father of Indian Chemistry'.

He had his early education in Calcutta. In 1882 B.Sc., 1887 D.Sc., from the University of Edinburgh. On return to India he joined as Asst. Professor in Chemistry, Presidency College, Calcutta; in 1916 retired as Professor and Head of the Department of Chemistry in the same college. Rabindranath Tagore said, "I offer felicitations to *Acharya*(Guru) ... could infuse a spirit of enquiry in his students..."

Cattle - bones experiment :

He used to collect bones of dead cattle and store them in the yard, much to the annoyance of the neighbours due to the foul smell. Once when he made a bonfire of the bones, Police came to the spot. However, from the waste cattle bones he produced phosphate of soda having medicinal tonic properties.

1. In 1892 Ray started a small chemical industry in Calcutta which later came to be known as Bengal Chemical and Pharmaceutical Works Ltd. May it be known to the readers that Sri Pattabhi Sitaramayya started Andhra Bank in a small building in Masulipatam (now Machilipatnam) 75 years ago – Humble beginnings with noble thoughts ! Ray started the industry with a capital of Rs.800 only 105 years ago. In 1904 the working capital grew upto Rs.23,500 (70 workers) and in 1983 about Rs. 80 lakhs (5000 workers). This is a manufacturing unit for injectables, soaps, perfumes, alkaloids, toilet goods, disinfectants, etc. It has become a giant organisation now– beginning small, progress phenomenal.

2. In 1894 discovery of mercurous nitrate, a salt of the flowing metal, white crystals obtained by the action of cold nitric acid on mercury (excess); later step mercuric nitrate. This discovery added a new feather in his cap and emerged as a turning point in his career. The finding was reported to the Journal of Asiatic Society in 1896 and later published in the Journal of Chemical Society, London.

3. He began preparing ammonium nitrate, a colourless crystalline salt, used as a fertilizer and as a high explosive by mixing with T.N.T. and aluminium powder.

Ray and N R Dhar published a paper on the vapour density of ammonium nitrite. Ramsay and Veley warmly congratulated the authors. Ray was acclaimed as 'master of nitrites'.

In 1912 he attended the Congress of the Universities of the British Dominions; also he attended the 250th anniversary

of the Royal Society, London, as a delegate from Calcutta.

4. In the capacity of Palit Professor of Chemistry, he presided over the Indian Science Congress in 1920.

Mahatma Gandhi and G.K.Gokhale were his friends. He began wearing *Khaddar* (Khadi) and supported *Swadeshi* (indigenous) goods; boycotted foreign goods. He joined the 'Non-cooperation movement'.

Applied sciences develop *pari passu* pure sciences. The Sulphuric acid plant in Glasgow impressed him very much. Ray was interested mainly in inorganic chemistry.

Industrialization developed gradually with the technical advice of Ray; the Calcutta Pottery works, Bengal Enamel Works, etc. were the ventures.

Ray trained many students in the University College of Sciences in Calcutta. His students / juniors include Dr. B.B.Dey, Dr.H.K.Sen, Naik from Bombay, J.C.Ghosh, J.N.Mukherjee, Dr.S.S.Bhatnagar, Meghnad Saha, Prof.A.C.Ghosh.

Ray's *Autobiography* and *History of Hindu Chemistry* are famous.

He lived full 83 years of fruitful life and died in 1944, a year before the end of World War II. Scientists are people who live for others. Ray is a ray on the 'Scientific horizon'.

Madam— a palindrome

MARIE CURIE

Marie Curie (1867-1934), French Physicist and discoverer of Radium. Marie Curie who was born in Warsaw, the capital of Poland was known popularly as Madam Curie: her maiden name was Manya Sklodowska. After she married Pierre Curie, she was known as Marie Curie.

Teenage anecdote

When seventeen-year- old Manya danced like a sprite and spoke like a scholar in an occasion, a youth from the University of Warsaw fell in love with pretty Manya; she returned the love. But,the mother of the youth did not allow marriage.

"I mean to say farewell to this contemptible world. The loss will be small..." wrote love sick Manya to her cousin.

Despite this unhappy experience pretty, blonde with lithe of frame, Manya wooed Pierre.

The age-old tradition of denying education to women in Poland debarred her from pursuing higher studies. Undaunted, she went to Paris for higher studies, where along with improving her knowledge she chose a partner in life, Pierre Curie.

Pierre had written, "Women of genius are rare". He found the rare woman in his wife ; his wife was a genius.

In research, her attention was focussed on radiacitivity. She took some pieces of Uranium, the rays of which affected photo-plates.

The Curies obtained huge quantities of Pitchblende (it is the basic mineral and the main source of Uranium and Radium). It was a hard task to extract Radium from Pitchblende —a pin head size of radioactive material from a mountain of ore !

They worked under dire circumstances, under a tin roof with holes; rain water would seep in, spoiling all setup —thus, they worked against odds, with great determination. Soon, their hard work was rewarded.

In 1898, the substance obtained from Pitchblende, when kept in a tube was found to glow. Thrilled by this, the Curies named it 'Radium'. In 1903, the discovery of Radium fetched her fame and a Nobel Prize in Physics.

Radium is used for several other purposes, e.g. to combat cancer. Radium needles are introduced into a body cavity, such as mouth, cervix of uterus, to treat cancer at those sites— cure in the hands of Curie.

In 1911, Marie Curie was again awarded the Nobel Prize, this time in Chemistry for her work on isolation of Polonium and Radium. She is probably the only one to win two Nobel

Prizes for two different categories.

Five Nobel Prizes were bagged by the family of Curie – two by Madam Curie, one by Pierre Curie, one by her daughter Irene Curie and one by Irene's husband. No other family in the world has ever won five Nobel prizes, a distinction of laudable service in sciences, beneficial to humanity at large. This is a unique example of devotion to science by members of one family.

Marie Curie developed blood cancer and leukemia due to exposure to radioactive materials and died on July 4, 1934. Such was the tragic end of a scientist. The radium she had discovered, consumed her.

Two Brothers who conquered the skies

WRIGHT BROTHERS

Wright, Orville and Wilbur, aviation pioneers invented the first successful self-propelled airplane in 1880 and 90s.

Orville Wright (1871 to 1948) and Wilbur Wright (1867 to 1912) popularly known as "Wright Brothers" were the sons of Milton Wright, a clergyman.

When we travel in cool comfort in the pleasure of euphoric mood, up in the sky about 25,000 ft. high, the gesture of gratitude should go to the above poineers.

In 1878 the father gave the sons a toy made of paper, bamboo and cork which would fly upto the ceiling in a room. An idea flashed in their mind whether a bigger structure would fly to greater heights and longer distances. They started making kites and gliders.

As a hobby, both brothers started printing news items. magazines.

Later they started manufacturing bicycles.

The original enthusiasm to make flying objects reigned supreme in their mind. Otto and Gustav Lilienthal of Germany were experimenting on similar lines to devise flying machines. In 1896 Otto Lilienthal died in a gliding attempt. This gave a rude shock to Wright brothers.

Wilbur thought the flying machine should be equipped with wings capable of moving up and down during the flight. Both brothers went to Carolina for conducting trials; in 1899 a kite- shaped biplane was designed.

A beach near kitty Hawk, North Carolina was selected for their flight experiments, after consulting the weather bureau. In 1902 about 700 glider flights were organized at kitty Hawk. In 1903 Orville Wright made the historic flight on a 12 h.p. biplane; the plane reached a height of 10 feet and stayed in air for 12 seconds covering a distance of 37 metres. Later Wilbur flew a distance of 850 feet in one minute. Those were the small beginnings.

Wilbur went to France in 1908 and made flights upto 91 metres. Death snatched him after an attack of typhoid.

In 1909 the American Wright company was established in New York. The mantle fell on Orville after his brother's death. He set up the Wright Aeronautical Laboratory in 1916.

Orville could reach flying speeds upto 300 miles per hour. Present day is the age of supersonic jets with a speed even faster than the speed of sound!

Rolls Royce is still a familiar name on the engines of the plane.

The original plane used by Wright Brothers for their historic first flight in Kitty Hawk, N.C. is preserved in the National Air and Space Museum, Washington D.C. as a relic.

Names of Military planes:

B-24 Liberator, 1938.

B-17 Flying Fortress World War II bomber —Flying speed 406 km/h, altitude 7,620 m (25000 ft).

B-29 Superfortress dropped atomic bombs in 1945 at

Hiroshima, Nagasaki.

B-52 Strato Fortress in 1950s.

B-1 bomber, Rockwell international supersonic bomber 1963-74.

International passenger flights:

Boeing Jumbo Jet 737, 747 Air bus, Tristar, Concord

Indian scene:

The first scheduled service was inaugurated in 1932 by J.R.D.Tata flying mail and passengers between Karachi, Ahmedabad, Bombay, Madras.

1933 Lores Bonney : First woman to fly from Australia to England.

Present day:

Air India, International flights.

Indian Airlines, Domestic flights.

Singhania satisfied his ambition as a hobby to pilot his own plane from London to Bombay around the year 1988.

In May 1991 Rajiv Gandhi himself piloted his plane on the historic 'doom flight' before the blast of his body with a bomb occurred in South India while in preparation to address a meeting.

"Wireless" wizard

MARCONI

Guglielmo Marconi Marchese (1874 to 1937) "Father of Wireless" was born in Italy in the year 1874, got educated in physics.

Young Marconi took keen interest in Heinrich Hertz's experiments on electromagnetic waves which stimulated newer ideas in Marconi's mind that such waves could be transmitted without connection of wires. Actually Heinrich Hertz laid the foundation for radio, television and radar.

One night in 1894 he did an experiment in the presence of his mother. In a room he positioned an electric bell and a Morse key 30 feet apart; on pressing the key the bell rang.

Next he placed his self-made 'transmitter set' on one side of a hill and the 'receiver' on the other side. Messages were transmitted. By 1897 he could transmit radio messages upto a distance of 12 miles.

The principle of the electric telegraph and radio (wireless set) was the same. Messages could be sent without the intervention of wires; hence the name "wireless". The term "radio" is confined to the communications system transmitting audio signals (wireless).

Marconi offered his wireless communication system with lue humility to the Italian Government but obtained refusal of ecognition in his own mother country. Such a frustration for

a scientist is not uncommon in one's own career, on his own soil! Notwithstanding this, he patented this machine in London. Subsequently he founded his "Wireless telegraph company". In 1899 he transmitted radio signals across the English channel, a distance of about 31 miles.

In 1900 he cleverly got patented his four-circuit tuning set.

In 1901 radio-wave signals were sent from Newfoundland to Cornwall in England; he sent signals across the Atlantic. This was a great day in the history of "wireless".

By this means, ships at sea could send messages for aid, in case they are in trouble; armies locked up in ambushes or fortresses could signal for necessary help.

He shared the Nobel prize for physics in 1909.

When he died in Rome in 1937, a two-minute silence was observed by all radio stations throughout the world. This bears testimony to the honour people bestowed on this great scientist in recognition of the razzmatazz.

In the present day:

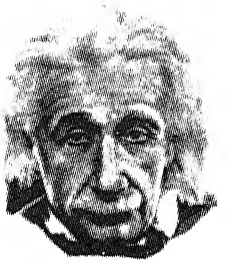
All India Radio, BBC (British Broadcasting Corportion) feed news items punctual on time. People are benefited by the broadcast.

In the early part of the 20th century radio was a craze; now TV has replaced radio—with evolution of time and gadgets, niceties also improve. [analogy : Computer jeering typewriter].

Tuning the radio was a status symbol at one time; now, of course, switching on TV has become a more prestigious life style. Live telecast is the norm of the present day.

A scientist difficult to understand

EINSTEIN ALBERT



Einstein Albert (1879 to 1955) "Father of Modern Physics" was born in the German city of Ulm. Music was an attraction right from his childhood; he hated army parades wherein human beings moved like machines.

At the age of ten he entered a "secondary" school called a *Gymnasium* where Catholic preaching was dinned into the ears this shrewd Jew. After his graduation in the *Gymnasium* he came into his own fold of Jewish community, though harassed by the Hitler- Nazi regime.

At the age of twelve Einstein valued as a treasure two articles – a watch fitted with a magnetic compass presented by his father and Euclid's geometry.

At his age of fifteen his father moved to Italy but young Einstein continued in the *Gymnasium* wherein things were not to his liking. He left it and joined his father in Italy.He wanted to make a career in mathematical physics, moved to the famous Swiss Federal Polytechnic School in Zurich, Switzerland. After completing education, he joined as an examiner (post of clerk) in the Swiss Patent Office in Berne in 1900.

though his ambition was to become a physics teacher.

The genius in him was evident by the notes solving problems of mathematics, physics and problems of the universe.

At the age of 26 he got his Ph.D. degree from the University of Zurich. He published five papers, *vide infra*, the cream of his work, which venture made him world-famous.

1.The term radiation implies energy transfer to celestial bodies and living matter which is witnessed, for example, in

(i) life processes, eg., photosynthesis in plants,

(ii) harmful effects of radiation to human tissues.

Radiation

type i) Radiation is the emission of a form of energy in motion; the speed of such motion either equals that of light, also called "electromagnetic rays" which in turn, includes radio waves, micro waves, infrared rays, visible light, ultraviolet rays, X-rays, and gamma rays. These are characterized by zero mass when (theoretically) at rest. Speed of light in free space is 3 x 10^{10} centimetres per second or 186,000 miles per second.

type ii) also called "matter rays" includes such particles as electrons, protons, and neutrons. In a state of rest, these particles have mass; they are the constitutents of atoms and atomic nuclei. When they travel at high velocities, they are regarded as radiation.

Einstein showed that when light falls on metals like

tungston, they emit electrons. Photoelectrons are electrons ejected from a solid, liquid or gas by the photoelectric effect. Photoelectric effect is the emission of electrons from a solid (or liquid) surface when it is irradiated with electromagnetic radiation.

2. Brownian movement observed under a microscope wherein the microscopic particles are continuously bombarded by the invisibly small molecules of the fluid in a container.

3. Relativity: Einstein's theory of the universe, which shows that all motion is relative and treats time as a fourth dimension related to space.

"Special Theory of Relativity" in which Einstein postulated that the physical qualities like mass, length and time are not constant, but vary with the velocity of the body. A traveling clock runs slower than a clock that is at rest.

Einstein remarks at the mathematical simplicity out of the laws governing the Universe. "God" he said, "does not play at dice."

Yet, it is beyond the comprehension of the common scientist because of its complicated interpretation.

4. Transformation of matter - into - energy law: energy (E)is equal to the product of mass (m) times the speed of light squared (c^2) written as $E = mc^2$.

Basing on this equation, if one pound of matter is con-

verted into energy, it would be equivalent to the energy generated by burning seven million tons of dynamite! Such a fantastic explanation lies behind the creation of the atom/atomic bomb. So, mass (matter) could be changed into energy, and energy could be changed into matter (Einstein,1905). Since the velocity of light is a huge number, 186,000 miles per second or 300,000,000 (three hundred million) metres per second, the energy obtained from even a very small amount of matter is very high, indeed.

Albert Einstein regretted very much the use of atom bomb when it was dropped in Hiroshima and Nagasaki in 1945. He advocated peaceful uses of atomic energy for the benefit of mankind.

Hazard of radiation : 'Hitherto man had to live with the idea of death as an individual; from now on mankind will have to live with the idea of its death as a species.'

– Arthur Koestler

5. He proved that light travels in the form of particles called photons (also called "quanta"). Photons are pieces of light energy.

In 1921 he was awarded Nobel Prize for physics. In 1933 when the Nazis came to power, he was treated rudely. He proceeded to the United States and became the Director of the School of Mathematics in the Institute for Advanced Study at Princeton; became a U.S. citizen in 1940.

In 1950 he published the physical laws of gravitation and electromagnetism. Einstein opined that Newton's law was valid as long as one was dealing with weak gravitational forces, e.g., on earth. But when massive heavenly bodies are involved, e.g., quasars, black holes, etc, Newton's law is not applicable (see Issac Newton).

In 1955 he died while he was in deep slumber. His brain was removed and preserved in Princeton hospital, to study more about the mystery of this genius.

He devoted his life to the advancement of both knowledge and peace. To honour this apostle of peace, an element "einsteinium(Es)" of atomic number 99 has been named after this scientist. All einsteinium isotopes are radioactive.

Ninety years in nuclear physics

HAHN OTTO

Hahn Otto (1879 to 1968), a German scientist, discoverer of nuclear fission, an experimentalist in nuclear physics was awarded Nobel Prize in Chemisty in 1944.

He was born on March 8, 1879, obtained Doctorate in 1901. In 1904 he went to London to work with Sir William Ramsay who was interested in radioactivity. He returned to Germany in 1906.

During the World War I (1913 - 15) he was a Chemical Warfare specialist; this gave him an opportunity for the application of radioactive methods to chemical problems.

In 1934 Hahn got keenly interested in the work of the Italian Physicist Enrico Fermi, the basis of whose theory was : When uranium is bombarded by neutrons, several radioactive products are formed. Fermi did work on the above project.

Discovery of Nuclear fission

One of the products from uranium was a radioactive form of the much lighter element barium, indicating that uranium atom had split into two lighter atoms. The principle behind this led to the explosion of atomic bomb in Hiroshima in 1945. Hahn was aged 66 at that time, still a vigorous person,mountaineer who maintained physical fitness.

Hahn arrived at a new radioactive substance, named by him as *radiothorium* which emanated from a crude radium preparation given to him by Ramsay.

On return to Germany he was elected President of the former Kaiser Wilhelm Society, renamed the Max Planck Society for the Advancement of Science. He was the head of the Department of radio-chemistry at the Kaiser Wilhelm Institute of Chemistry in Berlin. Lise Meitner, an Austrian physicist was his trusted colleague.

After World War I, Hahn and his colleague, Miss Meitner announced the discovery of a new ratioactive element, *protactinum.*

He campaigned against further development and testing of nuclear weapons.

"God, for his own inscrutable ends, made everyone blind to the phenomenon of *atomic fission*"

—an assistant of Fermi

In 1966 Hahn and his colleagues, Meitner and Strassmann shared the prestigious Enrico Fermi Award.

Hahn died on July 28, 1968 after nearly ninety years of fruitful life.

Hard work is the name of the game for this scientist.

SIR ALEXANDER FLEMING

Sir Alexander Fleming (1881-1955), Scottish bacteriologist discovered penicillin, the wonder drug against infections in those days.

At the age of 47 in the year 1928 he began working on staphylococcus, the bacterium responsible for causing boils, pimples and other sores. In bacteriology parlance, the word 'culture' indicates the nutritious substance, i.e., the meal or food for the micro-organisms. There are various culture media suitable for the growth of various micro-organisms. The growing groups of micro-organisms are called colonies. They are usually grown on petri dishes.

Experiments were conducted by Fleming in the laboratory of St.Mary's Medical School and Hospital in London. He had filled some petri dishes with the germ staphylococcus, in the pursuit of his antibacterial experiments. To his surprise, he found that the bacteria failed to grow in one dish and he noticed that some light blue or grey coloured bits resembling the flecks of fungus over stale bread, were present in that dish. He surmised that this was due to contamination by a gush of wind or air which swept the dish at the start of the experiment.

Though this was a chance finding, it led to the definition of an antibiotic. An antibiotic is a chemical substance produced by a micro-organism which is inimical to other micro-organisms. Hence an antibiotic has an antibacterial property or action. Fleming noticed that wherever the fungus had grown, the micro-organisms had died. The fungus was 'penicillium', a rare fungus in the mould family, species of a plant, *Penicillium notatum*. The fungus is present in the air. The fluid obtained from the penicillium fungus was named penicillin.

By then, Louis Pasteur had already proclaimed that germs cause diseases. Joseph Lister had discovered the antiseptic– carbolic acid, to kill germs. But this has a limitation in that it can be used only topically, i.e., for administration on the surface of the body. Penicillin enters into the deeper tissues and organs, and so can be used systemically, e.g. intramuscular injection.

Penicillin is useful to combat septicemia, i.e., blood-poisoning by germs; this substance kills the germs without killing the white blood corpuscles, the soldiers in action during an infection.

Penicillin kills germs that cause pneumonia, influenza, diphtheria, meningitis,etc., It is the sheet anchor of treatment for venereal diseases (sexually transmitted diseases) even in the present day.

In 1937 two chemists, Howard Florey and E.B.Chain

purified penicillin to make it more safe for administration. The Nobel prize for Medicine was awarded jointly to Fleming, Florey and Chain in the year 1945.

Fleming died on March 11, 1955 in London. Fleming's fame is as immortal as a flame.

Yet, wherever there are roses there are thorns. Notwithstanding the rosy picture of benefit, administration of penicillin is fatal in some cases who are allergic to it. Extreme caution is required in the administration of this drug in those who are sensitive/ hostile to this.

Humour in Medicine: Alexander Fleming discovered penicillin over the disc. Hence disc-over = disc+over.

Thick, heavy -set scientific giant in play with the microscopic atom.

BOHR, NIELS

Bohr, Niels (1885 to 1962) Danish physicist. Niels Henrik David Bohr, born in Copenhagen in 1885 did pioneering work in the field of atomic theory. It is said that the Danish are proudest of their shipping industry, dairy products and Niels Bohr.

At the age of 22 he was awarded the gold medal of the Danish Scientific Society for his original studies on surface tension.

In 1911 Bohr submitted a dissertation on the electron theory of metals and received his Ph.D. He went to Cambridge to study under J.J.Thomson, 'the father of the electron.'

In 1913 he published his basic theory on the structure of the atom. There are atoms of copper, or of neon or of uranium or of any element.

A central portion in the atom is the nucleus. Electrons move about in circular paths/orbits, likened to the solar system in which planets move about the sun. The nucleus is positively charged and made up of neutrons and protons; the electrons are elementary particles of negative charge, travel in "shells" around the nucleus.

The hydrogen nucleus consists of one proton; one electron encircling. The nucleus of helium consists of two neutrons and two protons; two electrons orbiting, Uranium has 92 electrons racing about in seven shells.

When electricity passes through the atom, electrons jump from one orbit to another, light is produced. Emission and absorption of light are characterised by a "quantum jump" between two orbits in the atom. When electricity flows through neon gas, an orange-red light glows.

In 1922, the 37 year young Bohr got the Nobel Prize in Physics. At that time he was head of the Copenhagen Institute for Theoretical Physics.

He studied "droplet model" of the nucleus in an atom, which considers the nucleus as if it were a water droplet held in position by its surface tension.

In 1943 Germans planned to arrest him during World War II. Niels, son of a Jewish mother , went to Sweden aboard the *Sea Star*, a small fishing boat. Bohr intelligently dissolved his Nobel Prize Gold Medal in a bottle of acid, to recast it later; hence the Nazis could not lay hands on it, in spite of search in the home.

From Sweden he went to the United States where he joined in the British American Bomb Project at Los Alamos.

Awestruck by the devastating effects of atomic bomb explosions in Hiroshima and Nagasaki, he pleaded for urgent

international control, but in vain. After the war was over, he returned to Copenhagen, was appointed Chairman, Danish Atomic Energy Commission.

He was Chairman of the Atoms for Peace Conference at Geneva in 1955. He received a $ 75,000 prize, Ford Atoms for Peace Award in 1957.

The grandfatherly looking, thick, heavy - set man with thick bushy white eyebrows, was having tremendous physical stamina. At the age of 54 he won a ski race at Oslo, Norway.

Death snatched him away in 1962.

Aage Niels Bohr, son of Niels Bohr shared a Nobel Prize in 1975 for discovering the asymmetry of atomic nuclei.

The greatest Mathemagician
Human brain is a super-computer

RAMANUJAN, SRINIVASA

Ramanujan, Srinivasa (1887 to 1920) World-famous Indian Mathematician, son of Srinivasa Ayyangar was born on December 22, 1887 in Erode (India).

During his childhood, in an arithmetic class, this budding genius posed a question to his class teacher, "If zero is divided by zero, will the result be one?"

The prudence about zero

0 is designated as a digit or number. If zero prefixes a number it has no value; if zero suffixes a number or if it prefixes a number with a decimal before it, it carries value. Hence we realise the importance of the position of 0 in a number.

(a) zero has got the ability to destory another number if it is multiplied by zero, eg. 452 x 0 = 0.

(b) It has no role in addition or subtraction, eg. 12 plus zero is twelve, 12 minus zero is twelve.

(c) In division what is its role? any number divided by zero is infinity

(i) 0/0 is zero according to some mathematicians.

(ii) 0/0 is one according to some.

(iii) 0/0 is equal to infinity according to Bhaskara, an Indian Mathematician.

(iv) 0/0 is regarded as an indeterminate form according to some.

Hindu mathematicians conceived of 0 as a number. Ancient Indian thought about zero is interpreted in this manthra:

पूर्णमदः पूर्णमिद पूर्णात् पूर्णमुदच्यते ।

पूर्णस्य पूर्णमादाय पूर्णमेवावशिष्यते ॥

Ramanujan was in a poor financial state; he could not get proper education. At the age of 15 he verified about 6000 theorems and developed some new theorems.

1. In the year 1903 he secured a scholarship after Matriculation. Since he was interested in mathematics and numbers, he neglected other subjects; the scholarship was cancelled. Parents were worried whether he would go mad.

2. In 1907 he appeared for F.A. (now called Intermediate).

3. To set him right, parents arranged a bride, Janaki who was eight years old at the time of marriage.

4. In 1910 he met V.Ramaswamy Iyer (Founder of the Indian Mathematical Society) and Ramachandra Rao (President of the Indian Mathematical Society), and showed his math-

ematics note book to impress them and thereby get a job.

5. In 1911 he got a temporary job in A.G.'s office, Madras.

6. In 1912 appointed as a clerk, Madras Port Trust on a salary of Rs.20 p.m.

7. In 1913 he got a research scholarship of Rs.75 per month from University of Madras for his proficiency in mathematics.

8. Ramanujan wrote a letter to Prof.G.H.Hardy of Cambridge University enclosing 120 theorems and other notes. Hardy and his colleagues were impressed and offered him facilities for study in Cambridge University.

Instance of unrest in his mind:

Ramanujan in an other letter to Hardy wrote that "lunatic asylum was his (Ramanujan's) goal". Hardy's reply ,"you must be prepared for a certain amount of disappointment."

9. Despite trepidations of his family members over the violation of the norms of orthodoxy for a brahmin to cross the oceans, he set sail to England on March 17, 1914 with an agreement of scholarship of £250 a year from University of Madras and £60 a year from Trinity College, Cambridge.

10. He was elected Fellow of the Royal Society in 1918 and Fellow of the Trinity College, Cambridge.

His contributions

He was a mathematician of the highest order who did

work on the theory of numbers, theory of partitions and theory of continued fractions. To him, mathematics was a game of partition of number into sums of squares, cubes and higher powers, eg., $1^3+12^3 = 1729$ also $10^3+9^3 = 1729$(loc.cit.) 1729 is called Ramanujan's number.

Yet, Ramanujan was cautious and cunning. He did not give his proofs to Hardy, for fear that Hardy might "steal" his findings! Thus Hardy was hardly trusted.

Unfortunately Ramanujan fell ill in Cambridge. Being a brahmin and strict vegetarian, he had to cook his own food. Furthermore, First World War was raging in Europe at that time to cause inconvenience to life and health.

In a mood of disgust and despair, he nearly attempted to kill himself when he fell before a train in England.

Hardy's comment:

"While many of his theorems were quite new... He discovered many theorems; persistent modesty for too big a man!"

While Ramanujan continued his research work in England tuberculosis attacked him; he became pale and weak. Had there been no Hardy, there would perhaps be no Ramanujan– Such an intimacy between them. Once when Ramanujan was sick with TB, Hardy paid a visit to him. Hardy said, " The number of the taxi-cab in which I came is 1729. The number seems to be a dull one and I hope it is not an unfavourable omen."

The genius in Ramanujan sparkled immediately. "No ; Hardy, It is a very interesting number. It is the smallest number expressible as the sum of two cubes in two different ways : $1729 = 12^3+1^3 \text{or} 10^3+9^3$ (loc cit). Prof. Hardy was amazed.

Once Prof. Littlewood remarked, "Every positive integer was one of Ramanujan's personal friends."

He was sent back to India in 1919. He died of consumption in the year 1920 in Chetput, Madras.

The old saying. "Those whom Gods love die young" was true in Ramanujan's case; he died at less than 33 years of age, hardly at one -third of the normal life-span. Such was the triumph and tragedy of a genius!

His wife Janaki outstripped him in age. She bore the grief of Ramanujan's death till her age of 85, until her death in 1994.

India Postage 15 np postal stamp was issued in his birth centenary year in 1987 in commemoration of this genius.

Postscript

Bertrand Russel was "excited" by the emergence of Ramanujan as a genius.

Hardy recorded his astonishing capability of mental calculation and thrill in the drill of his brain.

Nearly 60 years after his death, J.H.Whittaker in 1979

said, "The right place for the Ramanujan material was the Trinity College rather than India which had done nothing for him."

Besides being a mathematician, Ramanujan was a reputed astrologer, fluent speaker giving lectures on topics like "God and infinity".

"He was destined to leave for his heavenly abode in a hurry, prematurely in the crusade against TB. It looks as though some Divine hand picks up people packed up in an enormous quantum of intellect and creativity , as pawns for the TB.butcher/slaughter."

There is life in live telecast

JOHN LOGI BAIRD

Baird John Logie (1888 to 1946), Inventor of Television was born in 1888 in Helensburg near Glasgow. All through his life he had 'a hand to mouth existence'; on the top of it, he was suffering from spells of ill-health.

At the age of 26 after becoming an engineer, he worked in an electronic company on a meagre salary.

He changed occupations– manufacturing socks, later began making jam and sauce – these were not giving proper dividends.

During a journey to Trinidad, he had discussions with the captain of the ship in his cabin regarding the possibility of sending pictures through the air. The seed for the thought of broadcasting was sown; attempts to nurture it started.

In 1922 Baird at the age of 34 started experimentation to invent television. He improvised cardboard boxes, fitted a disc with many holes, rotated it with an illuminated source at its back ; such a source was either a projection lamp, selinium cell, neon lamp or radio valves. On rotating the disc, the light

spots could be detected on a screen.

In 1924 he refined the process of transmission and receiving the signals; he succeeded in catching upto a distance of three yards.

In 1925 with poor resources at his command, Baird made a primitive demonstration where pictures were blurred. On improving the light source, the conversion of light into electrical signals was more effective; quality of the picture improved.

In 1929 he demonstrated colour television .

In addition to the handicap of shortage of money to proceed with his trials, Marconi's "wireless system" (radio) overshadowed Baird's television round about the year 1936. Such were the teething troubles!

Colour TV - However, colour TV tried to replace the black and white TV round about the year 1945.

The Indian scene

Television was started in India on 15th September 1959 with the first demonstration of a 'closed circuit TV' at an Industrial exhibition organised in Delhi – The equipment was given by Philips India Ltd.

Present name for TV in India is Doordarshan -DD.

From the times of radio, which is an audio pleasure, we have advanced further to TV, an audio-visual pleasure!

People often tune TV for relaxation and entertainment.

TV coverage

*Prayer and Breakfast TV – bright start of the day.

*Advertising medium.

*Drama, plays, movies and feature films.

*Documentaries. *News and current affairs.

*Programmes for children like cartoons, animation scenes.

*Programmes for arts and sciences – Science and Technology.

*Light entertainment. *Education and religion.

*Sport: young and old derive much enjoyment from the World of Sports.

We are in a shrinking world with facilities for International travel, Tourism and Television. In TV, the pictures are being bounced by satellite from one continent to the other.

Colour, contrast, brilliance, volume adjustments in a TV set give the desired enjoyment while viewing a programme.

Humour on TV : The head of the family claims he has six controls on his TV–his wife and five children.

The Man of Science

SIR C.V.RAMAN

Chandrasekhara Venkata Raman (1888 to 1970)was born at Tiruchirapalli, Tamil Nadu in 1888. It is almost a house-hold name in India re-verberating 'Raman Effect'.

He passed MA in January 1907 topping the list and walking away with prizes. His thought was research-oriented, right from the college days in Presidency College, Madras. His first research paper was on diffraction of light.

In 1907 after passing Indian Civil Service (ICS) examination he became the Deputy Accountant General in Calcutta. He was studying problems in physics, inspired by the works of Einstein, Helmholtz. In 1917 he resigned from the post and joined as Professor of Physics at Calcutta University. Raman was a teacher *par excellence*.

The scientific elite in India have to respect Raman, Saha, Krishnan – they faced odds and struggles to develop science in this country. Raman and Krishnan remind us of the legendary Rama and Krishna, giants of Indian mythology.

Raman opined that Roentgen's epoch-making discovery of X-rays marked the beginning of new physics.

"Science is a fusion of man's aesthetic and intellectual functions devoted to the representation of Nature. Discovery is a dramatic, exiciting event like finding a fifty carat diamond in a ploughed field. The classic example is that of Archimedes who was excited on his discovery and came running, crying 'Eureka eureka'."

Raman's contributions

1. On cosmic radiation. The purpose of science is to obtain deeper understanding of the powers of Nature.

2. Studies in acoustics: (a) studies on vibration – percussion instruments: mridangam, tabla; stringed instruments: tambura, veena.

(b) Studies on Whispering gallery in St.Paul's Cathedral, London; in India, Gol Gumbaz in Bijapur.

3. Study in Optics: The wave-like nature of light is subject to reflection, refraction, diffraction. Oblique diffraction has also been described. Colour of heated metals is also due to diffraction effect. In 1911 a study: X-rays were diffracted by crystals and produced a well-defined interference pattern. Thus the use of X-rays to unravel the architecture of crystals was studied.

4. Raman effect: (i) monochromatic light from a mercury arc was passed through transparent materials, and was made

to fall on a spectograph to record its spectrum. He observed some new lines in the spectrum called 'Raman Lines'.

(ii) Suppose a beam of light is incident on a liquid (or on a solid or even gas). The incident light will either be absorbed by the molecules in the system or it will be scattered, called Raman scattering. He did work on scattering of light in crystals.

5. Why is the sea blue? It has nothing to do with the colour of the water. It is the blue of the sky seen by reflection.

6. Explanation of "Son et Lumiere" phenomenon – Shows held at Red Fort, New Delhi; Golconda Fort, Hyderabad, – night time entertainment. This is based on Raman-Nath theory – manoeuvre of light and sound effects to produce visual and auditory perception.

7. The Born-Raman controversy or dispute

He who never made mistake, never made a discovery

—Samuel Smiles

8. Raman's interest in crystal dynamics – Raman spectrum of Diamond. However, he received brickbats from jealous colleagues, which is not uncommon for Inventors and Discoverers.

Honours and awards

* 1924 elected Fellow of Royal Society of London.

* 1929 Italian Society of Rome awarded the Matteucci

Gold Medal.

* British Government conferred knighthood (Sir C.V.Raman)

* Faraday Society of London invited him for an address.

* University of Freiburg awarded a doctoral degree *honoris causa*

* Physical Society of Switzerland elected him as Hon.Member.

* The plum came in 1930. He received the Nobel Prize in Physics. Raman was 41 when he won the prize.

Why there is no parade for hero-scientists like Ramanujan and Raman?

Raman as a man – the man in Raman – His qualities, personality:

* child-like simplicity, yet a complex personality.

* child-like stubbornness, sometimes.

* his exuberance while speaking.

* sober scientist.

* he never hesitated to call a spade a spade.

* youthful daring till the end of his life.

* according to him, politics and science were poles apart. Hence he kept himself aloof from politics.

* Science dominated his life.

"Science was a window to Nature's majesty", he remarked.

One of Raman's gift to Indian scientists is the Indian Academy of Sciences. "I cannot remain idle for a single day", he used to say. He left no stone unturned to collect donations and

favours for his institute. "Our greatest men were beggars – the Buddha, Sankara and even Gandhi", he appealed thus.

He had deep compassion for children–"he wept like a child during one of the Academy lectures when pictures were shown of children of our land suffering from nutritional ailments". He envisaged a happy world of children, "If they (i.e., the young) are enthused and if they are instilled with a spirit of adventure, the sleeping giant will wake up and we can conquer the world."

When there is no hope, there is no life., "there is nothing worth in this world that can come without the sweat of our brow", he declared.

"What is needed in India is the destruction of that defeatist spirit (of inferiority complex)", he opined.

In 1968 Raman attained the age of eighty –*Octogenarian extraordinary.*

Notwithstanding his genius, there were some shortcomings in him:

*his dismissal of rivals.

*his disinclination toward woman scientists.

Replying to felicitations in a meeting convened to honour him at the end of the journey of his life, he remarked, "I wish some one had said that I had the heart of a lion"– such was the roaring desire and fuming enthusiasm of C.V.Raman, the Man of Science!

About the 'sweet 'disease

BANTING SIR FREDERICK GRANT

Banting Sir Frederick Grant (1891 to 1941), Canadian physician who working along with his assistant Charles H.Best obtained the pancreatic extract containing insulin from a dog in the year 1921. It controlled diabetes in dogs. Dog is a faithful friend of man. Surgeons and research workers learn their procedures first on animals, especially dogs.

He worked in colloboration with J.J.R.Macleod, Scottish physiologist at the University of Toronto. They refined the hormone and made it fit for use in humans.

Types of insulin

* bovine insulin obtained from the pancreas of cattle.

* porcine/ pork insulin obtained from the pancreas of pigs.

* human insulin prepared by recombinant DNA technique, using the bacteria *Escherichia coli.*

The above insulins are injected subcutaneously.

*insulin pump [colloquially called 'insulin pen'] inserted

into the abdominal wall subcutaneously, and it delivers insulin automatically into the system, as per the need. It is refilled every 4 to 8 weeks via a self - sealing valve under the skin. This device obviates the monotony of daily self-administration through a syringe.

In 1923 a department by the name "Banting and Best Department of Medical Research" was established in Toronto University and Banting was the first to occupy the Chair as head of the Department. After his death in 1941, Best succeeded and remained in that post from 1941 to 67.

Banting and Macleod were co-recipients of the 1923 Nobel Prize for Physiology or Medicine for the discovery of insulin. Because Best was only an undergraduate at the time of discovery, he could not share the Nobel Prize. But the gesture of gratitude of Banting was commendable in that he shared his portion of the prize with Best voluntarily. Later he was knighted in 1934. He died in 1941 in a plane crash.

Best Charles H(erbert) (1899 to 1978), Toronto Physiologist also discovered choline (a member of vitamin B complex group) and histaminase which is an enzyme.

He is reputed to have introduced anticoagulant therapy in the treatment of thrombosis (blood clots in blood vessels).

Book written by Best and Banting: *Internal Secretions of the Pancreas* (1922).

Insulin is a hormone produced in the pancreas which gov-

erns the metabolism of sugar (carbohydrate), the absence, deficiency or inaction of which leads to diabetes (mellitus).

Facts about diabetes

* In India one in every 12 people over the age of 30 in an urban setting have diabetes.

* In India 15 to 16 million suffer from it.

* Hereditary factor: If both parents are having type II diabetes, the chance of the offspring getting the disease is five times higher than that of non-diabetic parents.

* Uncontrolled diabetes can lead to severe complications—dermal, retinal, renal, cardiovascular and neurologic complications in succeeding decades.

* 50% of impotent people in the world are diabetics.

World Diabetes Day is being observed /celebrated on June 27, every year.

Advice to the diabetic : Eat less sweet to be more sweet.

DR.YELLAPRAGADA SUBBA ROW

Dr.Subba Row(1895-1948) was born in Bhimavaram in Andhra Pradesh. He conducted clinical trials in the Madras Ayurvedic College. Later, he went to Harvard and took the summer course at the Harvard Medical School (HMS). He always wanted to study Bio-chemistry.

Pernicious anaemia killed thousands of Americans every year. In India, Dr.Row's brother also died of anaemia while he watched helplessly. Subba Row thought that the isolation of the so-called Anti-Pernicious Anaemia Factor (APAF-Vitamin B 12) would be a sweet revenge against this dreaded illness.

His contributions

1. Rapid colorimetric method, 'Fiske-Subba Row' method. This is used to measure the amount of phosphorous in body fluids and tissues. The work was carried out in the Massachusetts Institute of Technology (MIT), Harvard School of Tropical Medicine, Boston, in 1925.

2. Phosphocreatine and Adenosine Triphosphate (ATP). He discovered that the above substances are the source of energy in muscular activity. This work was carried out in MIT in 1925.

3. Director of 'Lederle Research Laboratory', American

Cyanamid Company, New York, USA (1945 to 48) (a) He developed a deep tank production technique of Penicillin, to produce it in bulk. This was independent of the technique developed by Dr.Alexander Fleming, (b) Folic acid in treatment of tropical sprue, (c) Hetrazan in treatment for filariasis, (d) Aureomycin – first broad-spectrum antibiotic to treat infections, (e) Methotrexate, an antimetabolite – the first drug for cancer chemotherapy(treatment).

His Exploits

Research in liver extract in the treatment of anaemia. He published papers on pantothenic acid, biotin, miscellaneous B complex vitamins, steroids, TB, trypanosomiasis, cancer, blood pressure, etc.

He died of atherosclerosis and coronary ischaemia. The tempo of work and the vicissitudes of research activity in relation to successes and failures, might have contributed to the development of the above diseases.

Yellapragada Subba Row Memorial Oration is being delivered annually, arranged by the IMA, Andhra Pradesh Branch.

Of tropical eosinophilia fame

VISWANATHAN,RAMAN

Viswanathan,Raman, (1899 to 1982), physician, was born on 8th September, 1899 at Nagercoil, Tamil Nadu.

Educational qualifications

1921 B.A.Degree.

1926 MBBS degree.

1931 MD (Madras University).

1932 FRCP, Fellow of the Royal College of Physicians, London.

1938 TDD Wales (Welsh National School of Medicine, Cardiff)

Career

After return to India he joined as an Assistant Professor of Medicine, Madras Medical College and later worked as Professor, Andhra Medical College, Visakhapatnam. From 1942 to 1946 World War II —served as Medical Specialist in the Indian Army.

In 1946 Col. Viswanathan joined the Directorate-General of Health Services as the Tuberculosis Adviser to the Government of India. From1946 to 1964 Dean of the Faculty of Medical Sciences of Delhi University. He took over as founder Director of the Vallabhai Patel Chest Institute, New Delhi. In fact, that was his 'Temple!'

1953 visited United States as Leader, Exchange Programme, U.S.A.I.D. Regent for India of the American College of Chest Physicians.

Dr. R. Viswanathan was entrusted with the responsible job of investigating the cause of an epidemic of infective hepatitis in Delhi in 1957 - 58. He used his ingenuity in disclosing the culprit factor which was a leak of drainage pipe into Najafgarh nallah, a source of drinking water. This led to feco - oral contamination.

1963 President, 8th National Congress on Diseases of Chest.

1964 Emeritus Scientist, Council of Scientific and Industrial Research (CSIR) and Professor, University of Delhi.

November 1974 he organised World Congress on Asthma, Bronchitis & conditions allied, in New Delhi.

He published over 150 scientific papers in National and International journals. He was the author of seven books.

Fellow :

Elected Fellow of Indian National Science Academy, 1969.

American College of Chest Physicians. Academy of Medical Sciences, India. Indian Association for Chest Diseases. Indian Science Congress Association.

Awards and Honours:

Padma Bhushan; Honorary Physician to the President of

India.

In 1972 awarded Gold Medal by Tuberculosis Association of India for outstanding achievements.

Recipient of Dhanwantari Prize of the National Science Academy. Eugino Morelli Prize and Forlanini Medal from Italy.

His special contribution

Pulmonary Eosinophilosis (Tropical Eosinophilia): R.Viswanathan saw the first case in 1935 which was referred to him as a case of miliary tuberculosis. Later he could identify similar cases. He first gave a note in the Annual Report for 1939 of King George Hospital, Visakhapatnam (Vizagapatam in those days, abbreviated as Vizag), South India; this is an analogy to Guy's Hospital Records in London.

The course of the disease is benign and hardly ever fatal. Viswanathan has one more 'first' to his credit. The first case which came to autopsy in his hands died not of the disease, but due to a complication of arsenical encephalopathy which resulted from treatment with NAB(an arsenical preparation). This provided an opportunity for him to study the pathology in detail.

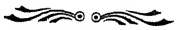
He died in harness on 14th July, 1982 in the centenary of the discovery of the tubercle bacillus by Robert Koch. In the 83rd year of his life he was exceptionally agile both physically and mentally. He was telling, "I would like to drive my car myself, not like to be driven."

He was a multi-splendoured personality— brilliant aca-

demician, a talented clinician, a gifted teacher, a prolific writer and a research worker of the highest calibre.

— *Indian Journal of Tuberculosis*, July 1982.

Colonel Dr.R.Viswanathan was an examiner in the M.D.degree examination for the author. Dr. O.A.Sarma, the author of this book obtained the degree of M.D. in General Medicine including Tropical Diseases, in the hands of this stalwart scientist.



A step into the atomic age

FERMI ENRICO

Fermi Enrico (1901 to 1954), Italian - U.S.theoretical physicist, one of the chief architects and pioneers of the *nuclear age* . He discovered the effectiveness of the "slow" neutron in producing artificial disintegration of the atom.

Fermi was born in Rome on September 29, 1901; he was a student prodigy at school. He took his Doctorate at the age of 21 in the University of Pisa. He taught mathematics in the University of Florence. The Royal Academy of Italy recognised his work and worth in 1929 by electing him as a member.

In 1932 an electronically neutral particle called 'neutron' was discovered by Sir James Ghadwick at Cambridge University. In 1934 positively charged helium nuclei from polonium were discovered; such nuclei resulted on bombardment of elements with alpha particles.

Fascinated by the above findings. Fermi began further experimentation. He opined that slow neutrons obtained from radioactive beryllium were effective in producing emission of radioactive particles.

When he used uranium of atomic weight 92 as the target of slow-neutron bombardment, he was puzzled to evolve some more radioactive substances. In 1938 Fermi was named a Nobel laureate in physics in recognition of the above work. Meitner working along with her nephew, Otto Frisch explained this new phenomenon as splitting of the nucleus of the uranium atom into barium, krypton and smaller amounts of other disintegration products.

Meitner, a mathematical physicist postulated that nuclear fission was accompanied by stupendous release of energy by the conversion of the mass of uranium into energy, in accordance with Einstein's 'mass-energy equation':

energy (E) is equal to the product of mass (m) times the speed of light squared (c^2), commonly written as $E = mc^2$.

Fermi and his colleagues alerted President Franklin D Roosevelt about the dangers of atom bomb; Hitler's scientists knew about it already. The Manhattan Project for the production of the first atom bomb began in 1942. Uranium-235 isotope would be the ideal one for a nuclear chain reaction. Fermi was entrusted with this job. In 1945 the testing of the first nuclear device took place in New Mexico; few weeks later atom bombs were dropped on Hiroshima and Nagasaki in Japan.

In 1942 the atomic pile in the University of Chicago released for the first time on earth a controlled flow of energy from a source other than the sun! This is a forerunner of the modern nuclear reactor which releases energy from matter to

be used for peaceful purposes.

Element number 100 was named *fermium*, after the name of Fermi in his honour.

Fermi Award was instituted by the U.S.Atomic Energy Commission. Fermi was the first recipient of this prestigious award of $ 25,000 in the year 1954. He died of cancer in Chicago in the same year.

Hip, hip, hurray to this 53 year young scientist! Those whom Gods love die young. Good men must die; but death cannot kill their names.

"God, for His own inscrutable ends, made everyone blind to the phenomenon of *atomic fission* "

– an assistant of Fermi

A cute scientist of 'atomic energy' fame

DR. HOMI JEHANGIR BHABHA

Homi Jehangir Bhabha (1909 to 1966), father of Indian nuclear programme, key person behind the establishment of atomic energy plants in India was born in 1909 in Bombay in a rich Parsi family. Besides his scientific skill, he had keen interest in painting, poetry and Western music.

He was proud to be a product of Elphinstone College, Bombay. Later he went to Cambridge and took his Ph.D. in 1934. He had the good fortune of working with Niels Bohr, Enrico Fermi. In 1937 Bhabha's specialized study was in cosmic rays, by which he became world famous. He did work on 'mesons' which are subatomic elementary particles more massive than electrons but lighter than protons and neutrons.

Bhabha returned to India in 1940.

Further bio-data and achievements

1941 Fellow Royal Society of London. Fellow, Indian National Science Academy.

1941-42 Reader and later Professor of physics at the Indian Institute of Science, Bangalore.

1942 Recipient of Adams Prize.

Professor, Cosmic Ray Research Unit.

1945 he founded the Tata Institute of Fundamental Research, later renamed as Bhabha Institute of Fundamental Research, Bangalore.

1948 First Chairman of the Atomic Energy Commission of India.

1951 President, Indian Science Congress, 1951.

1954 Padma Bhushan.

1955 Chairman, First United Nations' Conference on Peaceful Uses of Atomic Energy, Geneva.

Hon. D.Sc. by some universities.

1956 Apsara, the first atomic reactor built at Trombay (Bombay); Later Cirus and Zerlina added. Purnima - II uses Uranium (233) fuel. Dhruva, nuclear reactor installed.

Neutron reactor Kamini built at Kalpakkam, Madras.

1957 Hon.Fellow, Royal Society, Edinburgh.

1959 Fellow, American Academy of Arts and Sciences.

Scientific Adviser to Prime Minister Jawaharlal Nehru and Lal Bahadur Shastri.

First atomic power station established at Tarapur.

Plutonium plant instituted.

May 1974 First underground nuclear device exploded at Pokhran, India [code : "Lord Buddha has smiled"].

May 11, 1998 on Buddha Purnima Day three nuclear devices blasted in Pokhran, India [Lord Buddha smiled for the second time].

Two more nuclear tests were conducted on May 13, 1998 at Pokhran.

Chairman, Commission for the Peaceful Uses of Atomic Power. He advocated constructive benefit of atomic energy to humankind but not its destructive torture.

Nuclear hazard : Hitherto man had to live with the idea of death as an individual ; from now on mankind will have to live with the idea of its death as a species.

—Arthur Koestler

Dr.Bhabha died in an air crash on January 24, 1966, just two days before the Republic Day; Angel of Fate knocked away this life-time bachelor when he was to attend an International conference, making the nation mourn his loss.

He was a cute person. One newspaper described him, "He is clean and beautiful. He looks like a film director or actor."

Do you know ? India's atomic energy establishment at Trombay, Mumbai, inaugurated by Pandit Jawaharlal Nehru on January 20, 1957 was renamed Bhabha Atomic Research Centre on January 22, 1967.

VAKIL, RUSTOM JAL

Vakil, Rustom Jal, Physician Cardiologist was born in 1911 in Bombay.

1934 Graduate in Medicine (London).

1936 MRCP(London).

1937 MD (London) - He won Medals in London.

1938 Assistant Hon.Physician, J.J.Hospital & Grant Medical College, Bombay; Hon.Consultant & Physician, K.E.M.Hospital, Bombay.

Achievements

Renowned clinician and teacher, responsible for encouraging specialisation in Cardiology in this country; hence known as 'Father of Indian Cardiology'.

Rauwolfia serpentina : an alkaloid from a plant grown in Himalayas in plenty, contains an alkaloid 'reserpine'; Vakil made a discovery that this is useful in the treatment of hypertension (high blood pressure) and psychiatric diseases. He is known as 'Father of Rauwolfia'. Later, of course, this drug has gone into disrepute because of its side-effect of causing sui-

cidal tendencies.

Dr.Vakil had many 'firsts' to his credit: He was the first scientist to undertake studies on the incidence and prevalence of heart diseases in India.

His originality – new terminology in cardiac disorders: "Pre-infarction syndrome, hexalogy of the heart, Giant cell arteritis in aortic regurgitation, Transitory pulsation in coronary thrombosis and Subacute pulmonary oedema."

Books written by him 1. *Clinical Diagnosis*, 2. *Text Book of Medicine,* 3. *The romance of healing and other essays,* 4. *Heart in Health and Disease.*

Awards received

1958 Padma Bhushan.

1959 International Albert Lasker Award.

1965 Shanti Swaroop Bhatnagar Award.

1969 B.C.Roy Award.

1971 The V World Congress of Cardiology Souvenir Award by the Cardiological Society of India.

1973 The First Dhanwantari Award.

Fellow: Elected Fellow of International and National Medical and Scientific bodies:-

The Royal College of Physicians (London).

American College of Cardiology.

American College of Physicians.

Indian National Science Academy.

American Geriatric Society.

American Association for the Advancement of Science.

Royal Society of Health.

Royal Society of Tropical Medicine.

International College of Angiology.

International Academy of Chest Physicians & Surgeons.

His name was one of the four Indian Clinicians to appear in the "American Register of International notables"

Do you know? Cardiac disease causes one in three of all deaths, worldwide.

Producer of artificial genes in the laboratory

HARGOBIND KHORANA

Dr.Hargobind Khorana was born on January 2, 1922 at Raipur in Punjab (now in Pakistan).

In 1945, Hargobind Khorana went to Manchester University and obtained Ph.D. The irony of fate was that, three years later when he returned to India, he could not get a job. Dejected and disgusted, he went back to England.

His research in England yielded fruitful results. In 1959, he succeeded in isolating a substance called 'coenzyme A', which is an essential product in body metabolism.

Nine years later, at the age of 46, he was awarded Nobel Prize in Physiology and Medicine for his research.

Dr.Khorana contributed nearly 300 papers on research in genetics.

On his visit to India in 1969, he was awarded Padma Bhushan. Honorary degree of D.Sc., was conferred on him by The Punjab University, Chandigarh.

Khorana settled in U.S.A, a heart-rending instance of 'brain drain' to the mother country.

In 1970 he worked as Alfred Sloon Professor of Biology and Chemistry, Massachusetts Institute of Technology. His work on 'genetic code' was acclaimed world-wide.

Khorana synthesized 'artificial gene' –thus paved the way for 'recombinant DNA technology'. He and his team of 24 sci-

entists took more than 9 years to produce one gene 207 of *Escherichia coli*, a bacterium that lives in the gut (intestines) of humans and animals; they built it up piece by piece in the loboratory, i.e. *in vitro*. In August 1976, this man -made gene was "inserted" into *Escherichia coli*, and it began to function like its natural gene/counterpart.

A gene is a biologic unit of genetic material and inheritance. Each gene influences one particular characteristic and has particular nucleic acid sequence within a Deoxyribonucleic acid (DNA) molecule that occupies a locus on a chromosome in the nucleus of a cell. Each cell contains thousands of genes.

"Hereditary factors" are termed "genes". Genes are storehouses of genetic information ; they are comparable to microchips in a computer.

The gene is composed of deoxyribonucleic acid (DNA) in all living organisms; in few viruses ribonucleic acid (RNA) is the genetic material.

"Stop" and "Start" signals could be given to monitor gene function. The cascade of "genetic information retrieval" is thoroughly balanced in life, with some enzymes to "proof read" and "repair" the wrong signals. When the balancing acts fail, genetically inherited diseases occur.

Gene manipulation and gene transfer methods come under 'transgenic technology'.

Transplantation of organs from other species is known as xenografting; however, 'rejection' due to efforts to attempt pig-human organ transplantation are afoot in the minds of researchers. Transgenic technology has great potential in many fields in biology.

Acknowledgement is made for the material taken from the following books for which the publishers hold copyright :

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